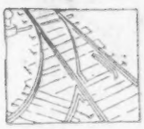
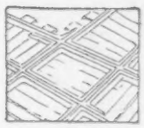
JUN 24 1929

ENGINEERING AND
MINING JOURNAL

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

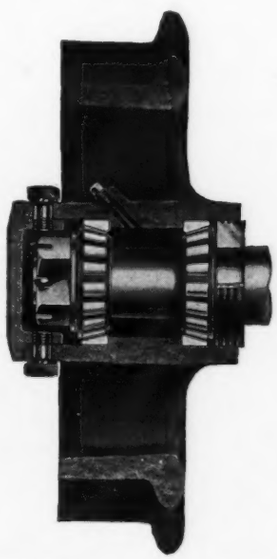
McGRAW-HILL PUBLISHING COMPANY, INC. June 22, 1929 TWENTY-FIVE CENTS PER COPY

Grades Curves

Switches  Crossovers 

Only Phantoms to

Timken-Equipped Cars



Thrust continuously fights economy in car operation. The reasons for Timken dominance are in their full radial-thrust and resultant load capacity; in their elimination of all possible friction and wear; in their compact, lubricant-retaining mountings and in their ability to keep wheels running freer and longer.

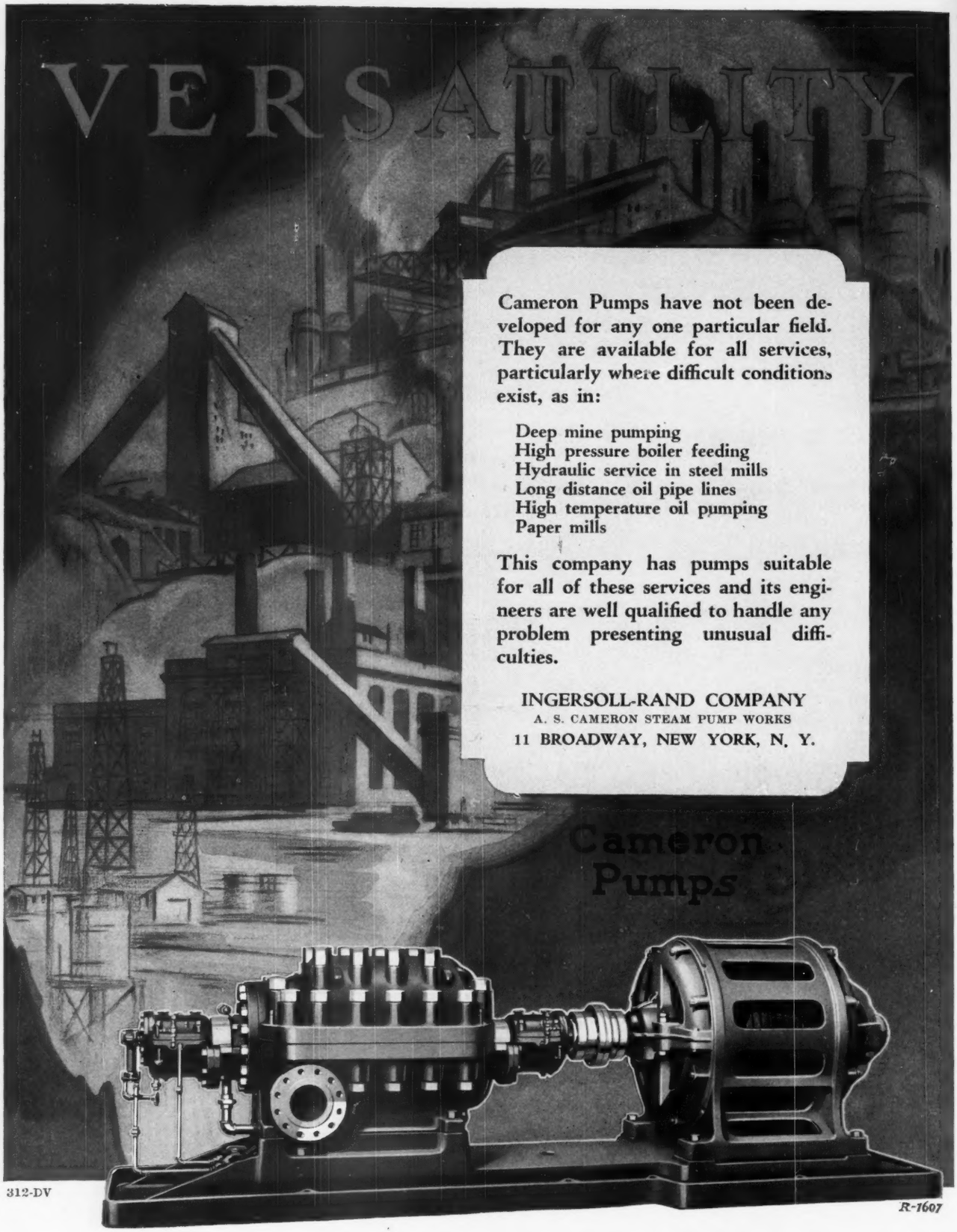
With Timken Bearings in mine car wheels or journals, "grade-load", "curve-thrust", "switch-sway", and "cross-over-shock" fade like phantoms because of the scientific safeguards provided by Timken full radial-thrust capacity and greater load distribution.

It is for this reason that thousands of mine cars have positive—yes, *positive*—assurance of increased earning ability based upon decreased operating and maintenance costs. Mine cars Timken-equipped start with less power, require almost no service attention and very little lubricant.

Skeptical operators in every field have seen the low-cost tonnage records made possible by Timken-equipped cars. In many great properties Timkens are standard. The industry is fast turning to Timkens because of the exclusive Timken combination—Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel—which is responsible for the most enduring economy.

THE TIMKEN ROLLER BEARING COMPANY
C A N T O N , O H I O

TIMKEN *Tapered Roller* BEARINGS



Cameron Pumps have not been developed for any one particular field. They are available for all services, particularly where difficult conditions exist, as in:

Deep mine pumping
High pressure boiler feeding
Hydraulic service in steel mills
Long distance oil pipe lines
High temperature oil pumping
Paper mills

This company has pumps suitable for all of these services and its engineers are well qualified to handle any problem presenting unusual difficulties.

INGERSOLL-RAND COMPANY
A. S. CAMERON STEAM PUMP WORKS
11 BROADWAY, NEW YORK, N. Y.

312-DV

R-1607

Ingersoll-Rand

A. S. Cameron Steam Pump Works

Volume 127

ENGINEERING AND MINING JOURNAL

Number 25

A consolidation of "Engineering and Mining Journal" and "Mining and Scientific Press"

A. W. ALLEN, *Editor*

Associate Editors: E. H. ROBIE, A. H. HUBBELL, New York. GEORGE J. YOUNG, San Francisco
Assistant Editors: W. N. P. REED, H. D. KEISER and HOMAR L. JOHNSON, New York. *Publishing Director:* H. W. CLARKE

New York, June 22, 1929

Scheduled for Next Week

An Interview with Leslie Urquhart
Manganese and the Bradley Process
Views of the Coast Tin-plate Industry
Reversed Classification by Crowded Settling

Contents

Editorials 985

Combined Power and Heating Offers Economy Opportunity
Putting the Fraudulent Promoter Out of Business
Importance of Accessory Equipment in Flotation Development
Copper Industry May Profit From the Experience of Steel
More Installations of Mine Rescue Apparatus Needed

All in a Day's Airplaning..... 988
BY A. J. MOORE

Mining Hard Hematite in Michigan.....991
BY LUCIEN EATON

Structural Characteristics of Zinc Ferrites.. 998

Annual Consumption of Reagents Used in Flotation 999
BY A. M. GAUDIN

Comment and Criticism	1004	Mining News	1011	Mining Stocks	1024
Digest of Current Literature	1006	Societies, Addresses and Reports	1017	Service Directory	33
Industrial Progress	1007	Market and Financial News	1018	Searchlight Section	34-36
Personals	1010	Markets	1022	What and Where to Buy	38-40
Obituaries	1010			Advertising Index	42

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

JAMES H. McGRAW, Chairman of the Board
MALCOLM MUIR, President
JAMES H. McGRAW, Jr., Vice-Pres. and Treas.
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
HAROLD W. McGRAW, Vice-President
C. H. THOMPSON, Secretary

NEW YORK District Office, 285 Madison Ave.
WASHINGTON, National Press Building
CHICAGO, 520 North Michigan Avenue
PHILADELPHIA, 1600 Arch St.
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission St.
LONDON, 6 Bouverie St., London, E. C. 4

Cable Address: "Machinist, N. Y."

Publishers of
Engineering News-Record — American Machinist
Power — Chemical & Metallurgical Engineering
Coal Age — Engineering & Mining Journal
Ingeniería Internacional — Food Industries
Electrical World — Electrical Merchandising
Bus Transportation — Electric Railway Journal
Construction Methods — Radio Retailing
Aviation
Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)

SUBSCRIPTION PRICES: United States, $6 a year. U. S. Possessions, Canada, Mexico and the countries of Central and South America, $7.50 a year. All other foreign countries, $10 a year. Single copy, 25 cents. Published weekly. Entered as second-class matter, June 20, 1879, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

CHANGE OF ADDRESS
Subscribers are requested to send both the old and the new address when they move to a new address.

Copyright 1929, by
McGraw-Hill Publishing Company, Inc.
Member—Audit Bureau of Circulations.
Member—Associated Business Papers.

11,438 Copies Printed This Issue

Total Number of Issues to Date, 3,287

HOAR SHOVELS

For Development Work

In driving crosscuts, drifts and adits, time and money can usually be saved by using mechanical mucking.

Hoar Shovels are widely used in this class of work, as well as in water, sewer, railway and subway tunnels.

The three independent, direct connected air motors of Hoar Shovels give the operator positive control of the machine at all times. The full revolving feature permits loading cars at the sides as well as at the rear of the shovel.

Other noteworthy features are the low initial and maintenance costs; ease of transporting from one working place to another; and improved ventilation in the heading.

Let us send you our latest bulletin No. 1824-A containing full details.

ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

ENGINEERING AND
MINING JOURNAL

McGraw-Hill Publishing Company, Inc.
James H. McGraw, *Chairman of the Board*
Malcolm Muir, *President*
H. C. Parmelee, *Editorial Director*

A. W. ALLEN, *Editor*

H. W. Clarke,
Publishing Director

Volume 127 — *New York, June 22, 1929* — Number 25

Combined Power and Heating Offers Economy Opportunity

A COMMON FAULT among specialists is seen in the failure to look beyond their own specialties. As a result, the advantages of diversified industrial operation are not always appreciated. This is especially true in mining enterprise, which rarely extends its influence beyond the production of the metal or the non-metallic mineral, thereby failing to take advantage of the economies possible by diversified operation under group control.

Steam is a valuable motive source, but it is also essential in many industrial operations as a mobile means of heating and drying and processing, and for the adjustment of atmospheric temperature in buildings during the cold seasons. To use the same steam, in successive steps, for both power and heating, is logical. If no opportunity for heating exists, an investigation should be made to determine if such opportunity can be provided, by extending the scope of operations. Thus only is it possible to secure a high efficiency from a steam power plant.

The total heat in steam at a high pressure is very little above that in steam at a low pressure. If useful work can be done, therefore, an obvious economy can be secured by taking more heat from the steam than is abstracted during its passage through an engine or turbine. In some plants the tail may wag the dog, as it were. In one industrial unit so much heat is needed that power is considered as a byproduct, delivered at negligible cost. Another instance may be quoted where the change from the use of raw to exhaust steam for heating purposes permitted a reduction of 30 per cent in the boiler plant, with savings in operating cost sufficient to pay for the new engine equipment within three years.

Power, on some mining properties, is obtainable only by means of steam, the exhaust being condensed and most of the heat wasted. But a high-efficiency non-condensing engine plant, with the heat from the exhaust steam put to useful purpose, is a most economical unit. Before buying power, or before planning to produce power from steam, therefore, every avenue of opportunity for the utilization of heat in the exhaust should be investigated. Many hydrometallurgical and some ore-dressing processes are influenced by the heat of the pulp or of the solution. Combined power and heat treatment insures negligible cost for either of the two operations, depending somewhat on the system of accountancy adopted. Two or more industrial ventures have thus been made profitable, whereas each operating alone—the one making its own power and the other its own steam for heating—could not meet expenses.

Putting the Fraudulent Promoter Out of Business

A CYNIC has remarked that one satisfactory method of accumulating a million dollars is to work hard and save all you can until you are fifty, and then inherit $995,500. The inference is not far-fetched. An ordinary individual, with family responsibilities, may work industriously and save to the utmost of his ability, but unless he can invest his small surplus in profitable enterprises—and they are legion—he is likely to lose it all, and even to run into debt. Whereas the stock market, offering opportunity for the rapid growth of individual wealth, is an open book to the investor with large means, a member of the financial middle classes who can save only a few hundred dollars per year out of a meager salary, must, to obtain security even without appreciation, be content with a savings-bank interest rate bearing no relation to the normal profits of American industry. He is therefore sometimes tempted by specious argument and glib persuasion to invest in fly-by-night mining ventures, get-rich-quick promotion schemes, oil flotation bubbles, and spurious real-estate developments, and invited to achieve affluence by financing the efforts of individuals who usually turn out to be crooks or cranks, or both.

To discourage the fleecing of the small investor of nearly $1,000,000,000 per annum in the United States alone, we have what are known as the blue-sky laws, state provisions limiting and controlling the issuance of stock to the public, and corrective action by the Post Office Department, which occasionally prosecutes when evidence is available that the mails have been used to defraud. The various Better Business Bureaus have also done excellent work, at least in keeping crooks on the move. But no agency to date has tackled the problem from the obvious, logical angle that it were better to provide an attractive, sound investment for the man of small means and small savings than to wait until a fleecing process is completed and then convict (if possible) the crook. To Mr. John J. Raskob must be given the credit of proposing a scheme of investment that should insure security for savings, and a reasonable interest rate, to say nothing of an appreciation in sale value of selected securities synchronizing with national industrial progress.

Mr. Raskob himself is a multi-millionaire, to whom great commendation is due for solicitude displayed toward those with lesser opportunities who have no chance to repeat, on a small scale, what the wealthy business man can do on a large scale. Another significant step forward in social reform will have been taken when Mr. Raskob's proposals are successfully consummated.

"I have been asked a good many times about the secret of wealth." he has said. "There really is no secret.

Generally, wealth is acquired by embracing an opportunity. And there is opportunity in this country for every man to obtain a share of independence. I hope to establish a medium that will bring opportunity closer to a large number of people. We shall offer the services and judgment of experts, such as they could never obtain otherwise. Purchases of stock will be made with an eye to basic security rather than large earnings. In no sense will they be speculative. But the fact remains that common stock holdings in industry may be both profitable and sound—as sound as our country and our national ideals. It is my impression that the average man has not heretofore had a plain and sufficiently well-guarded opportunity put before him to share in the wealth he creates."

Only a few individuals can become multi-millionaires, the number of millionaires, relatively speaking, is not large, and a comparatively small proportion of the population of the United States is wealthy. In the aggregate there is prosperity, but if we define the term with precision it must be admitted that, in reference to the great majority, it means no more than good food, adequate clothing and clean linen, protection from the elements, modern plumbing facilities, and moderate diversions. Insurance against accident (for the benefit of the insured) and against death (for the benefit of the survivors) has increased, and facilities for stock participation are being enjoyed by employees in almost every industry.

But Mr. Raskob goes further. His plan offers hope that the earner of even a small salary, who possesses the will to save, can avoid the pitfalls of fraudulent promotion and share with the capitalist an interest and appreciation return in keeping with the financial gains made in the great industries, including mining. The scope for fraudulent promotion will be severely decreased should Mr. Raskob's plan be introduced, and a vast amount of capital diverted into legitimate and profitable industrial channels, to the benefit of all concerned.

Wealth—something over and above our needs—brings opportunity for generosity toward others. The joy of giving might well be distributed more evenly.

Importance of Accessory Equipment in Flotation Development

A RECENT BULLETIN of the Mining and Metallurgical Society of America contains a statement by Mr. Stanly Easton, manager of Bunker Hill & Sullivan, which emphasizes the important part played by accessory and auxiliary flotation equipment in the simplification of flow sheets and for improving the physical condition of flotation products.

A natural tendency is to associate pioneer efforts in flotation development almost entirely with reagent experimentation and the application of various types of flotation machines. However, Mr. Easton's comment serves as a forcible reminder that present-day users of the flotation process are indebted to the spirit of research and pioneering that led to the development and improvement of pressure and vacuum filters, ball and rod mills, continuous thickeners, mechanical classifiers, centrifugal and diaphragm pumps, and reagent feeders, as well as other accessory equipment without which the successful operation of flotation plants would not be possible. The cyanide process was responsible in most instances for the invention and development of continuous-operation equipment of this character, but its utilization on an immense scale for flotation pulp and products has stimulated modification in design and insured an efficiency in operation that has had an important effect on results.

The technique of flotation continues to improve, and the percentage recovery attained approaches more closely to a practicable maximum; but, despite the great strides already made in this field, a need for further simplification of flow sheets and improvement in the physical condition of flotation products will manifest itself. The utilization of the flotation process has proved highly lucrative to companies which have been fortunate enough to be able to keep clear of legal entanglements. With the growing tendency of the chemical industries to adopt the equipment and practices of ore dressing and hydrometallurgy, future prospects are even brighter.

Copper Industry May Profit From the Experience of Steel

CHARLES M. SCHWAB, in addressing the American Iron and Steel Institute in New York the other day, made some interesting points that apply no less to the copper industry than to that of iron and steel. Said Mr. Schwab:

"As the expansion of the country's prosperity proceeds, some enlargement of our steel producing capacity may be required. But never before was it more incumbent upon us to temper our new plans with good judgment, to avoid speculative building, and to profit by the errors and mistakes of the past. We all know that the steel industry has paid dearly for over-expansion in the past, and many industries in this country still are suffering from the same evils forced by the war. Indeed, our own industry has but lately caught up with expansion due to this cause. Nothing causes business depression quicker than endeavoring to produce in excess of demand.

"Consolidations within the industry which have been effected in recent years have had a salutary effect in affording better control, co-ordination, and utilization of existing facilities, with consequent benefit to the employees and consuming public. . . . I cannot emphasize too strongly the fact that the intelligent relating of production to consumption is the most vital fundamental element in the success of any business.

"We cannot overlook the fact that the return should be sufficient to cover not merely payment for our manufacturing costs and the activities of labor, and reward invested capital, but also to make up for a huge yearly drain upon raw materials. The steel industry is basic. We are depleting our sources of ore and other raw materials at an enormous rate. The profit in the business, therefore, should be sufficient to compensate for the future expenditures that will be necessary to devise ways and means of replacing these raw materials."

For "steel" read "copper" in the statements quoted,

and they will be no less true. As a result of an expansion in demand that is now realized to have been in some part fictitious, with a resultant quick run-up in the price to 24 cents per pound, copper production facilities all over the world have been greatly increased and continue to be increased. But the experience of ten to fifteen years ago must not be repeated, either in steel or copper. Copper producers have certainly not forgotten the post-war depression, when not only excess capacity but excess stocks of metal burdened the industry for several years. The increase in production facilities must be temperate. In this connection, American producers must not forget that foreign companies, such as those in Africa, will expect to share in supplying the world's copper needs; but if these new African companies choose to disregard consumptive demand, and force production there to a high level at the earliest possible moment, they must not expect the older producers to curtail output in an effort to stabilize the market and avert the inevitable price decline that would result.

In the second paragraph quoted above, Mr. Schwab speaks of the beneficent effect of consolidations. In the copper industry as well, many consolidations have taken place, making for a more complete vertical as well as horizontal integration of the industry. These, aided by the intelligent leadership that we have reason to expect because of the caliber of the men at their head, should prove beneficent as well for copper as for steel. "The intelligent relating of production to consumption" is again emphasized as "the most vital fundamental element in the success of any business." Witness the recent 10 per cent curtailment in copper production announced by Anaconda as an example of constructive leadership.

Finally, Mr. Schwab emphasizes that mining, unlike manufacturing, is the exploitation of a wasting asset. In the June 8 issue of *Engineering and Mining Journal* Mr. A. B. Parsons discussed the cost of producing copper, as determined by various methods of bookkeeping. The average bare operating cost is perhaps well below ten cents per pound. But to this should properly be added taxes and interest, depreciation, and depletion. Nor is there any good reason why the precious metals, chiefly silver and gold, should be credited to the cost of producing copper. Why should not the producer make a profit on these as well? Why should he sell them at cost in the effort to make his bookkeeping cost of producing copper as low as possible? Exploration is expensive. Prospectors claim that the big mining companies are not willing to consider a property unless they are assured of certain success. Who can blame them if the public is not asked to consider any allowance for such items of expense in the cost of copper production?

For some time the price of copper has been eighteen cents per pound. Many think that a year from now a lower price will obtain, and if the bitter competition that we have seen in the past is renewed as soon as a surplus is on hand, a materially lower price must be expected—a price perhaps little more than sufficient to meet the bare operating cost. But indications point to a more intelligent leadership; to not only a desire but to actual constructive acts to set the selling price of copper at a figure consonant with production costs as commonly determined in other businesses. Increased stability would result; not the stability that characterizes aluminum and nickel prices, perhaps, for in copper too many competing interests are involved in both the domestic and world industry. Fairly accurate data are now available for the first time in the history of the industry as to the true current status of production and consumption. If each group in the industry uses these data intelligently, and does not adopt a purely selfish policy likely only to assure maximum immediate profits to itself, much greater prosperity for the copper industry than it has enjoyed in the last ten years should result. Much can be learned from the experiences of the steel industry.

More Installations of Mine Rescue Apparatus Needed

ONE OF THE MOST EFFECTIVE means of lessening the number of fatalities in the mining industry in recent years has been the utilization of self-contained oxygen breathing apparatus. Rescue parties, by means of this type of equipment, are enabled to penetrate irrespirable atmospheres and save the lives of workers that, in most instances, would otherwise be lost. Foremost in the promotion of the use of the apparatus in the United States has been the U. S. Bureau of Mines, which, from the time of its establishment in 1910, has made mine rescue endeavor an important part of its campaign for greater safety and efficiency in mining.

Soon after its establishment the Bureau equipped mine rescue cars and stations with oxygen breathing apparatus and began to train rescue crews in the various mining districts. The work has been continued steadily, until at present thousands of miners have been trained in the use and care of the apparatus. In addition to the trained and equipped crews of five men each, which most of the larger companies now maintain, some companies have established joint rescue stations. These facts are impressive, but more so when it is recalled that self-contained oxygen breathing apparatus was not introduced into the United States until about 1907. This early equipment was of German manufacture, and one of the first companies to employ it was Anaconda Copper, which installed the apparatus at its Butte mines. Later, other types were imported from England, but in 1918 several hundred sets of apparatus, the design of which was based on research and experimental work of the Bureau, were manufactured for the use of the U. S. Army and the Bureau. Subsequently, two other types were developed by the Bureau's technicians, and these, with the first model, have supplanted all other types of mine rescue apparatus in use in this country.

From a legislative standpoint, recognition of the importance of self-contained oxygen breathing apparatus in the mining industry is growing. In some states, notably Utah and Washington, mining codes require rescue apparatus to be available at mines of certain size and character. And in several states, mine insurance rates, under compensation insurance laws, for certain classes of mines, are considerably lowered by the installation of mine rescue apparatus and mine rescue stations.

Much has been done to promote the general adoption of oxygen breathing apparatus throughout the mining industry of the United States; the task, however, is far from completed. At any property where a shaft or underground fire might occur—to mention one of several possible applications—a crew trained in the use of, and equipped with, the apparatus should be maintained. Frequent testing of apparatus, together with regular training of mine rescue crews, should also be practiced. Legislation supporting such measures is desirable.

Over the range near Virginia City, Nev.

All

Nevadan Mining Observer Reminisces as Ghost Camps Are Passed and Comments on New Finds and Opportunities

BREAKFAST IN RENO, lunch at Las Vegas, dinner in Reno — all in the same day. The speedometer registers 730 miles for the round trip. Heretofore the record time by railroad from Reno to Tonopah, 273 miles, and from Tonopah to Las Vegas, 195 miles—only one way—has been nineteen hours. The trip one way by airplane from Reno to Las Vegas without stop was made in two hours and forty-five minutes. That's the time I made on May 3, 1929.

On the trip we pass over mining camps, old and new, credited with a gross production of over a thousand million dollars; over mountains of diatomaceous earth, beds of borax, salt, china, and filtering clays, brucite; ridges of cinnabar and tungsten ores, feldspar and many non-metallics, awaiting the completion of the Boulder Dam to produce more millions, to say nothing of the gold, silver, and lead in mines that are yet to be discovered.

At 7:40 we leave the Boeing Field, at Reno, in a Lockheed-Vega plane. At the controls is Captain Turner, who gained fame as an ace in the war. In a few minutes we are skirting the Carson River. Dotted here and there can be seen the remains of the mills that once lined its banks during the Comstock boom days. Now we are over Six-Mile and Seven-Mile canyons, which give promise of bringing back the Comstock Lode, to some extent at least. At the right, Mount Davidson looms. At its base, Virginia City—the most famous of all the ghost mining camps of Nevada. Its production of over $700,000,000 probably accomplished more than any other mining camp in the world. It laid the first Atlantic cable, endowed a state university, is credited with saving the Union, erected the Palace Hotel and other far-famed buildings of the San Francisco of before the fire and earthquake of 1906, made one American girl a princess and another a countess, and contributed substantially to transcontinental railroad building.

Only 25 minutes from the airport, and the Bluestone mine of the Mason Valley Mines is in sight. Right under us the Thompson smelter, owned by the same company. Now Walker Lake looms, and at its western tip is the Schurz headquarters of the Indian reservation and once the point of departure for Rawhide, now a ghost mining camp, but not until it had produced over a million. Back of it is Fairview, which produced over $3,000,000. Both camps are in line to stage a come-back.

A few minutes more and under us is the United States munitions plant. Just beyond is Hawthorne, back of which may be seen the hill over which the stage once passed daily to Aurora, at that time a booming camp, wearing ruts deep in the hill, ruts so deep that road repairing was in order. Then it was discovered that the ruts were in galena, and so the Lucky Boy mine was discovered. It made John H. Miller a state senator, and brought wealth to him and to his associates. It is now the Hawthorne mine, with a 100-ton mill that resumed operations recently.

At 8:35 we are over Mina, the point of departure for prospectors to the mountains in all directions. Three minutes more and we are over Sodaville, once the stage depot for Tonopah. A few miles at the right is Gold Canyon, where the Kernick Divide is operating. A little further back, Camp Douglass is seen, with three properties working in a small way. Interest just now centers in a clay deposit at the left, which is shipping three carloads a week to the oil companies of California and preparing to double the output.

Now Coaldale, Nevada's Black Hope, is at the right. For years a small coal mine has been in operation. San Francisco capital is now testing out the ground at depth by core drills. At the north is the ghost camp of Gilbert, closed more from litigation than lack of ore. A plan to build a mill was nearly financed when the promoter was killed in an auto accident, and matters are now at a standstill. At 8:54 the Tonopah Mining Company's mill at Millers is directly under us, and Mount Brougher is right ahead, with Mount Oddie peeking from behind it.

At exactly 9 a.m. Captain Turner banks the plane directly over the spot from which in 1904 Jim Butler picked samples and took them to Klondyke to assay.

in a Day's Airplaning

By A. J. Moore
Mining Editor, "Nevada State Journal"

But he had no money to pay for the work, so they were thrown out the window into the assayer's back yard. Later, Butler met a young man named Tasker L. Oddie and told him that if he would have the samples assayed he could have an interest in the new find, if it was worth locating. The result of the assay built the town of Tonopah, made Tasker L. Oddie Governor of Nevada, and later United States Senator.

As the plane banked over Tonopah, I looked down from its window and was reminded of the lines by an unknown poet:

"I am the Desert—barren since time began.
Yet do I dream of motherhood,
When man one day, at last, will look upon my charms
And give me cities like children to my arms."

Captain Turner now steers a straight air-line course for Las Vegas. At the right is the camp of Divide, now with only one producer and that operated by lessees. Over Klondyke, at 9:10, we slip past Columbia Mountain, which hides the site of the Goldfield Consolidated Mines' 1,000-ton mill, and Goldfield is in view. In the foreground is the 110-ft. gallows frame of the Goldfield Deep Mines, where the most ambitious exploration work in Nevada is in progress—a shaft 2,150 ft. deep, equipped with pumps to handle 1,500,000 gal. of water a day, with a crosscut out 2,900 ft., from which one drift is now out over 500 ft., and another over 700 ft., in an effort to undercut the spots from which the bonanza orebodies of early days were drawn.

In the airplane is George F. Smith, postmaster of Reno. He and I walked the streets of Goldfield in the days when over 30,000 people from all parts of the world congregated there, drawn by the lure of gold. We hardly started to reminisce of the Goldfield days when another ghost looms—Bullfrog; and just beyond it, another—Rhyolite. On the main street of Rhyolite still stands the big brick building of the Rhyolite bank. No single pane of glass is left to reflect the sunlight. It stands as the sightless skull of the ghost.

Below us is another ghost, the roadbed—all that remains of the Tonopah & Tidewater Railroad, over which thousands traveled but a few years ago. Now comes a bright green spot—Beatty, with its trees in bloom and grasses flourishing. Over at the right are the mountains that hold the old camp of Pioneer, where the Mayflower and Pioneer Consolidated each struggle for a come-back. Only a minute and we are over the brightest spot of Beatty, the little home of Loftus, he of Loftus & Davis, of Goldfield Great Bend fame, now spending the declining years of his life among the flowers and fruits he loves so much. The Amargosa desert, miles upon miles in length and miles in width, spreads out before us. We are not too high to note the Spanish Bayonet, the Yucca trees, and other desert flora. We wonder what this desert land would yield under irrigation. A sample of what it could do under encouragement has been glimpsed at Beatty.

Back of the Loftus home runs the road to the mushroom camp of Leadfield, to reach which C. C. Julian, at a cost of $40,000, built one of the most picturesque of

Looking down on Tonopah, Nev.

mountain roads. Leadfield as a ghost boasts a brand-new shroud: Every building along its three blocks of deserted street was under construction not more than three years ago.

We now skirt the range that is the scene of Nevada's

At the Gold Ace glory hole, Carrara, Nev. Left to right: A. J. Moore, the author of this article; Jim Shea., panning; Charles F. Smith, postmaster, Reno; Briz Putman, who made the discovery; G. Raymond Boggs, president of the Gold Ace Company and vice-president of the Lockheed-Vega Air-Line Company in the foreground, standing beside a pile of ore.

latest gold boom—Carrara. Captain Turner drops a small parachute to which is attached a stone around which is wrapped a note saying that we will land there at 2:30—on the return. A few minutes more and we are over the flat country back of Las Vegas. We feel lonesome out there, because heretofore the mountains have been at each hand, sometimes on both sides. They seemed quite neighborly, and we miss them.

Nature certainly intended that Las Vegas should grow, and so gave it plenty of room. One can easily spot the artesian water belt. The line of demarcation between dry desert and water lands is as a bright strip of green paint on a gray background.

At 10:25 we settle down on the landing field at Las Vegas, having made the trip in two hours and forty-five minutes, a month's trip by burro, ten days by team, or nineteen hours by train and auto. Such is the day we now live in. I can recall that when a kid I made a crude velocipede by patching together two wheels from an old buggy. I have seen the velocipede develop into the bicycle, the bicycle into the motorcycle, the motorcycle into the automobile, and the automobile into the airplane. With this in view, what holds the future for today's kid of twelve years or so, with an equal span of life before him?

As per promise, we land at Carrara at 2:30 on the return and spend nearly two hours at the scene of the new strike. Carrara has one of the finest landing fields in the state. Why not? It has a big stretch of Amargosa desert in front of it.

Tonopah Belmont Development Company had an option on the ground and later gave it up, but this has nothing to do with the merit or otherwise of the property. The main workings are in ore running from $8 to $10 per ton. The Belmont people never worked or prospected any part of the ground on which the strike is located—nearly a full claim length from the Belmont tunnel. As it was a low-grade proposition, the Belmont management wanted an extension to prove more ore. John Blitzer, from whom the option was obtained, thought that, inasmuch as over $30,000 had been expended, the option would not be relinquished, and demanded the cash balance. Later, he tried to induce them to go back; but, having pulled out, they refused to deal with him. Years later the ground lapsed and was relocated.

Briz Putman and Jim Shea, who had been partners in the Union No. 9 at Manhattan and other high-grade propositions, later got possession and interested G. Raymond Boggs, president of the Lockheed-Vega Airship Company, in the property. It was Putman and Shea who prospected the other end of the property. On the day of my visit, May 3, 1929, the high grade had been opened nearly 100 ft. in length and from two to 15 ft. in depth over the full length. A short tunnel at the north end shows only a fair grade of ore, about $20 per ton. Beginning about 15 ft. south of the tunnel the high grade comes in on the surface. Good pannings are obtainable at any point along the trenching. From the bottom of the deepest portion for a length of 12 ft., the finest specimens are obtained. Postmaster Smith got down into the trench and broke down about 1½ lb. at random over the 2 ft. next the hanging wall. Mortared and panned. it showed a string of gold 5 in. long, one-half inch wide at the center and over one-quarter inch deep.

A three-compartment shaft has been started about 100 ft. back of the outcropping. On the day of my visit the shaft was at a depth of 25 ft.—about the limit of economical work by windlass. A hoist and other shaft equipment are on the way to camp.

G. Raymond Boggs, who, in addition to his airplane activities, is president and general manager of the Gold Ace, says that none of the high grade will be shipped. The richest will be treated in a barrel amalgamator and

Las Vegas, Nev. Union Pacific yards in foreground.

the remainder used as a sweetener for the low-grade ore blocked out in the main workings. So far the flow sheet consists only of a ball mill, classifier, and four amalgam plates.

The mill is now being changed to permit finer grinding. If, with the addition of high grade to bring mill heads to $25 per ton, the tailing shows too great a loss, a cyanide or a flotation plant will be installed.

Mining Hard Hematite in Michigan

Methods and Costs

By Lucien Eaton

Superintendent Ishpeming District,
Cleveland Cliffs Iron Company, Ishpeming, Mich.

THE mining methods described in this paper are those used in a large mine producing hard specular ore on the Marquette range in the upper peninsula of Michigan. Although the conditions of mining described are unique in this district, they are similar to those in many other districts, and information in regard to the methods used and the results obtained should be of interest. The methods now used are an outgrowth of those of former years which have been adapted to conform with improvements in mechanical appliances, changes in the wage scale and labor supply, and the selling price of the product.

Geology of the Deposit

The ore occurs in the Upper Marquette Series of the Huronian Period, and is overlain by the Ishpeming quartzite and slate, with a footwall of jasper and altered diorite. It occurs as an irregular bed, badly folded and faulted, varying in thickness from a few feet to 100 ft., with an average thickness of 25 to 30 ft. in the larger orebodies (Figs 1 and 2). There is an unconformity between the ore and the hanging wall and probably in many places between the ore and the footwall, although the latter is not easy to determine.

In general the ore occurs in a syncline with an axis running east and west. This axis is not straight, but pitches downward to the east and to the west from a high point near the middle of the orebody. Both sides of the syncline are present only near the middle, as one side or the other has been removed by erosion or displaced by faulting in the other parts of the mine. Three major longitudinal faults have been recognized, and several minor longitudinal and cross faults are known to exist. The dip of the ore is irregular and in general is too low for the ore to run on the footwall by gravity. This fact, and the occurrence of many interbedded seams of rock in the ore, have had an important influence on the choice of the method of mining.

The ore formation is overlain by quicksand from 50 to 100 ft. deep, and the orebodies have been followed for long distances under the business portion of the town where the surface rights are not owned by the mining company. For these reasons it is necessary to use a method of mining that does not involve disturbance of the surface.

The ore is a hard, specular hematite low in silica and moisture and containing appreciable amounts of lime and magnesia. The iron content is high, about 59 per cent as mined; the phosphorus content is 0.10 per cent, and the silica is 5 to 7 per cent. It is separated into two grades, "lump" and "crushed." The physical structure, low moisture, and low silica content make the lump ore especially desirable for the open-hearth furnace.

Fig. 1—North-south cross-section through shaft, looking east

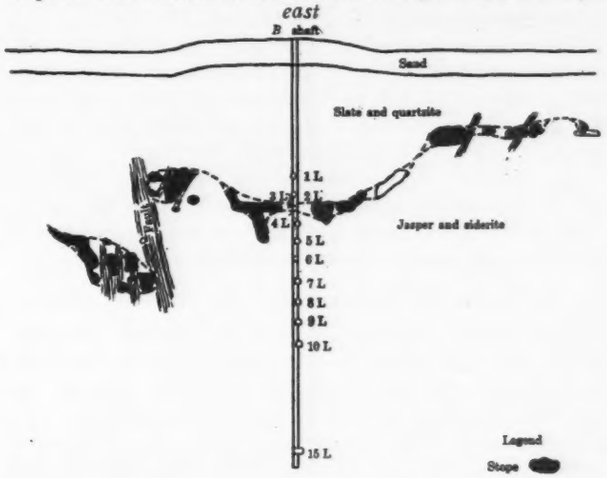


Fig. 2—North-south cross-section, 2,100 east

The ore is tough and hard to drill, and it stands well on exposure to the air. Seams of rock from 1 or 2 in. up to 1 or 2 ft. in thickness often occur in the ore and must be sorted out by hand underground. This fact and the flat dip of many of the orebodies have made the use of shrinkage stopes impracticable, and a system of open rooms and pillars, with the ultimate recovery of many of the floors, has been found to meet the situation admirably.

In most places the hanging wall is a slate which slacks when exposed to the air; for this reason a small amount of ore is left to protect it wherever possible. Overlying the slate, which is seldom over 15 ft. thick and usually much less, is a strong, hard quartzite which does not weather or swell when exposed to the air, and which

Printed by permission of the Director, U. S. Bureau of Mines. (Not subject to copyright.)

Acknowledgments—For much of the information in regard to the early history of the mine the author is indebted to Mr. James E. Jopling, of Marquette, Mich., who has been a mining engineer in the district for over 45 years. Information has also been taken from reports of the U. S. Geological Survey and the Geological Survey of Michigan, from publications of the Lake Superior Mining Institute, and from articles written by the author for the *Explosives Engineer* and the *Engineering and Mining Journal*.

forms an excellent capping for the stopes in the system of mining employed. Under the slate in some places is a conglomerate of jasper and ore.

The footwall is jasper or altered diorite. The jasper stands well under all conditions, but the altered diorite occasionally gives trouble, especially where it lies at a steep angle or has been sheared by faulting.

Displacement of the orebodies by faulting and their irregular size and occurrence have made prospecting difficult and it is impossible to block out large bodies of ore for mining. Great flexibility in the method of mining is required, and the ability to follow the ore wherever it goes is essential. These two conditions, as well as the inadvisability of caving the surface and the necessity of sorting out waste rock underground, have been determining points in the choice of a mining method.

In many parts of the mine where there has been a good deal of faulting a small amount of magnetite has been formed in the hematite mass; this has seriously interfered with the orientation of local strikes and dips and has complicated the study of the geology, especially of the many systems of joint planes.

The mine is situated at Ishpeming, 16 miles from Lake Superior, and is served by three railroads. Most of the ore is shipped by rail to Marquette and thence by water to Lake Erie ports, but a substantial tonnage is shipped entirely by rail to Canada and to the Chicago and St. Louis districts. The demand of customers for lump ore of high quality and of limited size range has had an important bearing on the choice of mining method and on the treatment of the ore at the surface.

Methods of Prospecting and Exploration

The earliest exploration was by vertical diamond-drill holes from the surface; a great deal of ore has been discovered in this way. In later years the underground workings standing open have become very extensive, so that it is now more economical and more effective to explore by horizontal diamond-drill holes underground. One diamond drill is kept in use nearly all the time, and averages over 2,000 ft. of hole per year. Over 400 holes have been drilled underground during the life of the mine.

Drilling is done with a screw-feed drill driven by compressed air, using "E" rods. Two men are required underground, and part of a diamond-setter's time is needed on the surface. As the mine is piped with air and water for the rock drills, there is little difficulty in making a set-up anywhere.

A large part of the exploration is by drifts and raises, and the orebodies are usually developed by breast stopes and raises. The old rule of following the ore is a very valuable one in this mine.

Methods of Sampling and Estimating Tonnage and Grade

Production samples are checked by samples taken at intervals from the stopes and drifts and by the appearance of the ore. Only one grade of ore is hoisted, so that the sampling is a simple matter. The standard methods adopted by the mining companies of the Lake Superior region and by the Lake Erie chemists are used on the surface. These methods are fully described in the "Methods of the Chemists of the U. S. Steel Corporation for Sampling and Analysis of Iron and Manganese Ores," third edition, from which pertinent extracts are published in the 1927 edition of Crowell and Murray's "Iron Ores of Lake Superior."

Estimating the tonnage of ore available in the mine is an intricate and arduous task. With a few exceptions the orebodies are most irregular, and their outline is not fully known until a large part has been extracted. The orebodies on each level are carefully mapped, and the amount of available ore is calculated as closely as possible. Gross tonnage is also calculated, and the difference between the gross tonnage, the sum of the available ore, and the ore already extracted is the amount left to support the surface. The different pillars and floors are numbered, and a record is kept on special maps which are brought up to date once a year by substracting the ore mined from, and adding the new ore developed to, the figures for the previous years. This system is practically a continuous inventory. It is checked by recalculations every few years.

In calculating developed tonnage, allowances of 10 per cent for incidental rock and 10 per cent for loss in mining (in this case mostly ore left to protect the hanging-wall slate and in the rounded corners of the arches of the rooms) are deducted from the gross amount.

The analysis of the ore in the different parts of the mine is estimated from composite stope samples for each year, and from the results of diamond-drilling allowance is made for contamination by incidental rock.

Values are calculated according to the formula of the Lake Superior Iron Ore Association. These calculations are too intricate to be included here, but may be found in the 1927 edition of Crowell and Murray's "Iron Ores of Lake Superior," page 107 *et seq.* At the present time a base ore (51½ per cent iron natural—that is, undried) of non-bessemer grade is worth $3.25 a ton at the mine. For specific ores the price fluctuates according to analysis.

Development Through Two Shafts

Shafts—The mine is opened by two shafts, "A" and "B," 820 ft. apart. The shafts are vertical, are 1,060 ft. deep, and their bottom levels are 1,000 ft. from surface. They are similar in design, 10x14 ft. inside of timbers, and are close-timbered for 750 ft. In the last 310 ft. sets were placed on 5-ft. centers in the usual way, but this was found to be a mistake, as the ore that was spilled from the skips cut the wall plates away, and inside lagging had to be put in. There are fifteen levels. The first level is 340 ft. from surface; the intervals between the next four levels are 40 ft. each, but below the fifth level the interval is 50 ft. Levels between the tenth and fifteenth, however, are not connected directly with the shafts, and all the ore below the tenth level is transferred to the fifteenth level by chutes. Figs. 3 and 4 show the outline of the orebodies and the development on two levels of the mine.

The shafts originally had two compartments, each 6 ft. 8 in. by 10 ft. One compartment was for the cage and the other for the Cornish pump, pipes, and ladders. In 1910 the arrangement was changed by substituting a 5-ton skip for the cage and by adding a counterweight. The skip road was moved to one end of the cage compartment, and a pocket was built at the other end on every active level (Fig. 7).

On account of the hardness of the ore and the large chunks handled, the skip is very heavily constructed and weighs approximately 10,000 lb. It is provided with safety catches, has a small platform on top of the bail, and has a bonnet on the rope for the protection of men when riding. The skip is overbalanced by a 6½-ton

counterweight, which travels inside a 12-in. pipe in the ladder and pipe compartment of the shaft. The counterweight consists of cast-iron cylinders, 11½ in. in diameter and 5 ft. long, strung on a 3-in. wrought-iron eyebolt 31 ft. long. It is free to turn in the pipe.

Drifts and Crosscuts—Except in the slate and diorite the ground in the mine is very hard, and nowhere is timbering necessary for the support of drifts and crosscuts. Practically the only timber used in the mine is that

Drills of the water-Leyner type, mounted on 3-in. single-screw bars 7½ ft. long, are used entirely in drifting. In very hard drifts, or in those in which rapid progress is desired, two machines are used on one bar. There is one miner for each machine.

The new drills used are of several makes and the latest models; all are 3½-in. machines weighing approximately 150 lb. All machines use anvil-block chucks and 1¼-in. hexagon hollow drill steel. Double taper cross

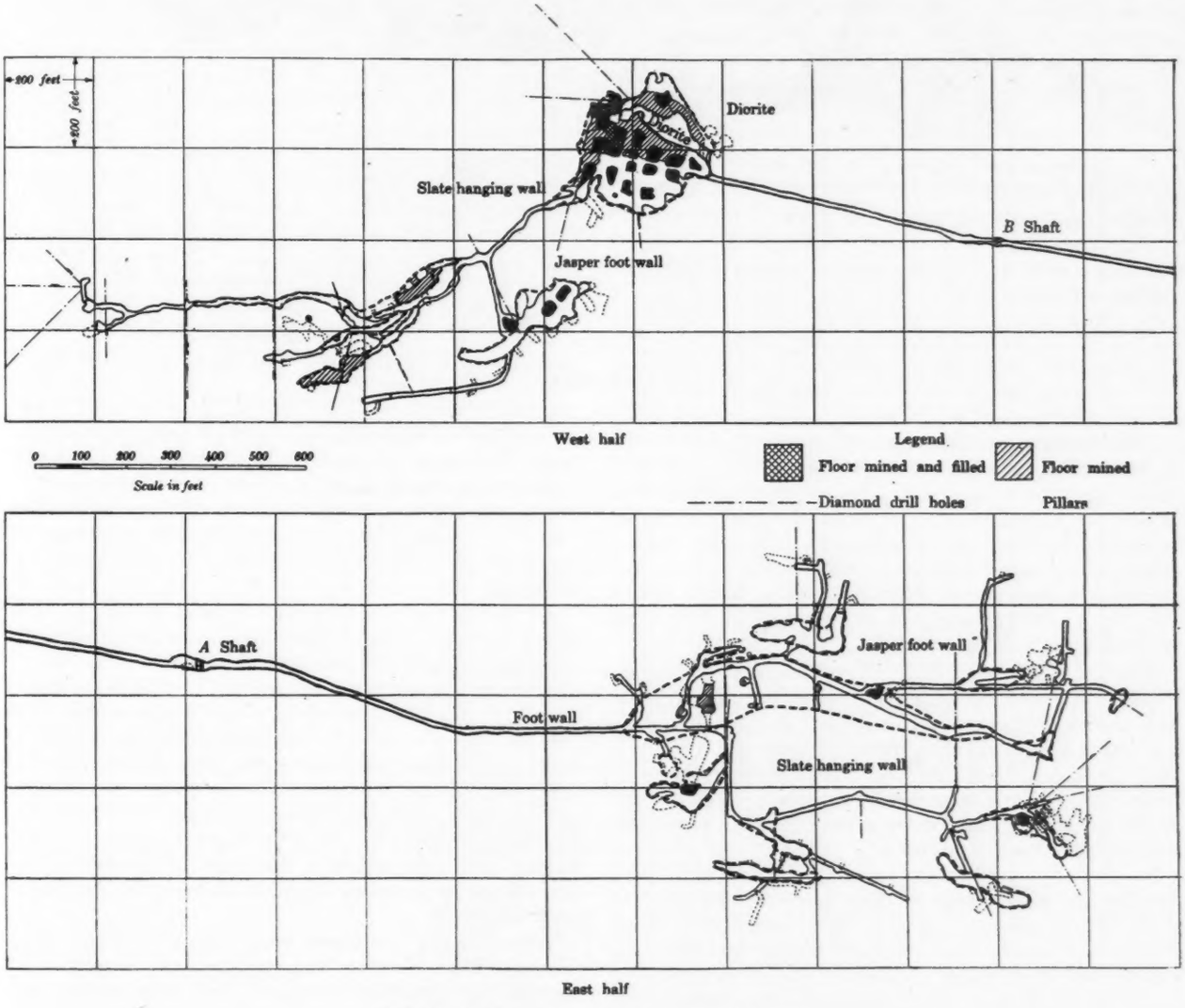


Fig. 3—Outline of orebodies on tenth level

in the shafts, chutes, and ladder roads. The older drifts were driven 7 ft. high and 7 ft. wide, but the standard drift is now 8 ft. high and 8 ft. wide. On main levels where trolley locomotives are used, wider spaces are excavated every 100 ft. for safety zones.

The usual round drilled has the cut above the center, and two cuts are taken out before the bench is blasted out. This is gradually being changed to a center-cut round, which is squared up at the same time that the cut is blasted. In drifting, 60 per cent gelatin dynamite in 1½x8 in. sticks is used, and the holes are fired by caps and fuses. A typical round is shown in Fig. 5A. The numbers show the order in which the holes are fired. The drilling and blasting are done on the day shift, and the broken rock is loaded and hoisted at night. All waste rock is dumped underground and is used as filling.

bits with 105-deg. cutting edges are used, the gage changing $\frac{3}{32}$ in. for every foot of length. Sizes are arranged so that a 10-ft. steel will drill a 1⅝-in. hole. Compressed air is delivered at a minimum pressure of 75 lb. per square inch at the drill and water at 50 to 75 lb. per square inch. The average air consumption is 75 cu.ft. per minute per machine, including line loss, at peak load.

Loading is nearly all done by hand. A dipper-type loader has been used successfully, but as it requires that the air compressor be run at night it is not economical, because loading and hoisting of rock is the only work carried on at night. Experiments with a scraper-loader mounted on wheels and driven by electricity have been very successful, and more of these machines will be used in future. Loading was done at the rate of twenty tons an hour.

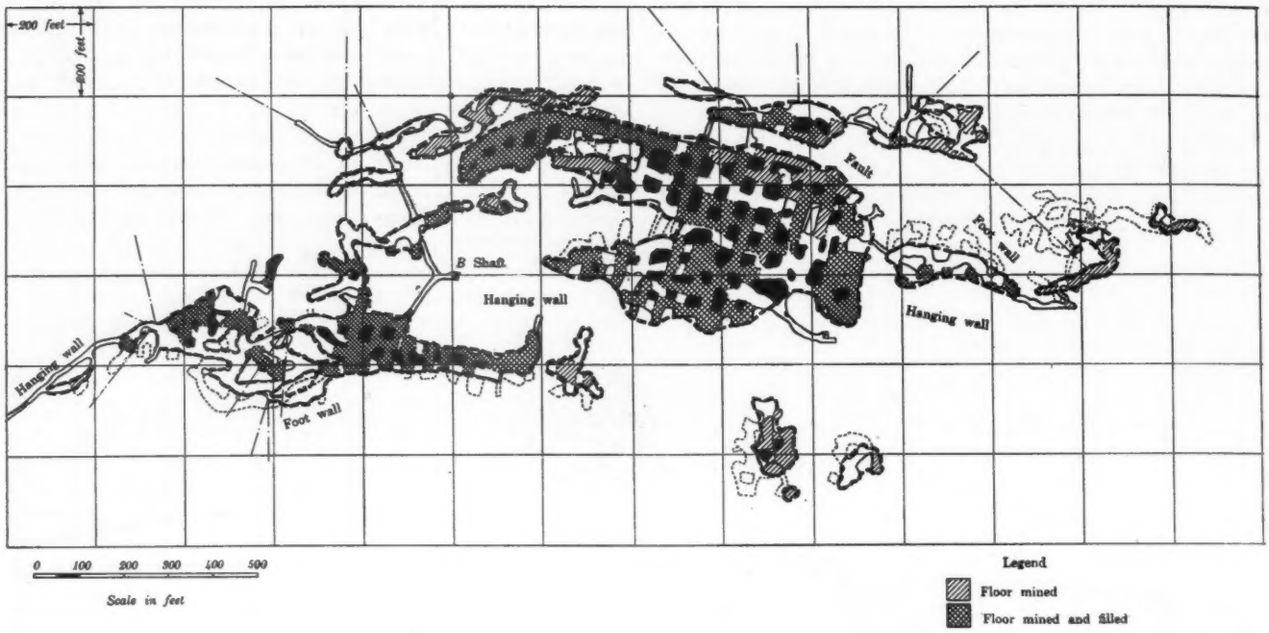


Fig. 4—Outline of orebodies on second level

Drifting is by contract, the miners being paid by the foot. They are charged for explosives, carbide, and hand tools, but drill machines and accessories, steel, and compressed air are furnished without charge. Shoveling and tramming the rock is charged against the cost of drifting, but is not included in the contract. In softer ground it is possible to drill and blast a round once a shift, but in hard ground this is accomplished only twice or three times a week.

Raises—Raises are 6x6 ft. in cross-section. They are usually driven at an inclination of 45 to 55 deg., but most are inclined at the steeper angle. A short pyramidal cut similar to that used in drifting is generally used. In hard ground a 3½-in. drifting machine mounted on a short 3-in. bar, the same used in drifting, is employed; but in the softer ground a dry stoper, using ⅞-in. quarter-actagon solid steel, is preferred.

No timber is used in the raises, and the miners work standing on stages made of 2-in. plank resting on drill steel. Chain ladders, made of ¾-in. round iron, hung from iron pins driven into short drill holes, are used for the men to climb on. These are left in the raise during blasting, and are often bent and sometimes broken, but in general they serve their purpose well.

Breast Stoping Where Ore Thickness Permits

Mining is done by open stopes with pillar support. A large percentage of the floors between the pillars is recovered, but no attempt is made to recover the pillars themselves, as the ore is overlain by quicksand and much of the mine is under the city.

Where the thickness of the ore will permit, rooms 25 ft. wide and 25 ft. high are driven by breast stoping, and floors 25 ft. thick are left between levels. On the upper levels the floors are only 15 ft. thick. The rooms are advanced by breast stoping (Figs. 5B and 6B). A cut 7 or 8 ft. high and as wide as the stope is driven 10 ft. ahead of the bench, which is taken up afterward by lifting holes drilled horizontally. The cut is driven by slabbing holes, and advantage is taken of slips wherever possible. The success of the method depends largely on keeping the corners ahead and properly squared up. When the cut is far enough ahead, the breast is drilled again but not blasted, and the broken ore is cleaned off the bench. Lifting holes 8 to 10 ft. deep are drilled 5 or 6 ft. apart in horizontal rows with a burden of approximately 5 ft. The whole breast is then blasted at one time.

As the bottom holes do not reach in as far as those above, a toe is left as a start for a new bench, and the broken ore lies on this toe in a pile high enough to allow the miner to reach the back at the breast conveniently. The back and breast are then trimmed, and drilling for the next cut is started. This method has many advantages. It facilitates trimming the back, always leaves a bench or a pile of broken ore for the miners to stand on, and provides a fairly continuous supply of broken ore for the trammers. It also gives a good opportunity for picking out rock before it has been discolored by the ore. As there are many seams of slate in the ore, this is very important.

When the ore in a breast stope does not extend up to the next level, it must be mined by back stoping. In starting this operation a stage is built with ladders and 3-in. planks, and from it as many holes are drilled as possible. These holes are charged, the stage is taken down, and the holes are fired. The stage is erected again, more holes are drilled, and the operation is repeated until the pile of broken ore is high enough for the miners to reach the back without the stage. The stope is carried up to the top of the ore, and is then advanced longitudinally over the stope below. The ore is broken down by horizontal holes drilled in rows; these holes can often carry a 6-ft. burden. At this stage the trammers usually start at the other end of the pile of broken ore, and tram it out as the stope advances, always leaving enough ore for the miners to stand on.

Extracting Floor Pillars—In mining floors, present practice is to work on a sublevel instead of mining the entire 25 ft. and dropping the ore to the level below (Fig. 6A). In starting, a raise is put up, a chute erected, and the ore around the raise is milled into it by underhand

work down to a depth of 18 ft. When the ore will no longer run into the chute by gravity, it is shoveled by hand and later dragged by scrapers. The scrapers are particularly effective in this work because the footwall is often so flat that the ore would have to be rehandled several times if it were shoveled by hand. Raises are usually about 100 ft. apart, as the scrapers can easily reach 50 ft. in either direction from the chute. When the ore has all been mined down to the floor of the sublevel, the remaining 7 ft. can be mined in one lift and dropped to the level below.

Breast stopes (Fig. 5B) are advanced by driving a 7-ft. cut along the top of the breast for the full width of the stope. The holes are 7 to 8 ft. deep, for which 50 per cent extra-low-freezing ammonia dynamite constitutes the charge. When a heading has been sufficiently advanced, it and the lower bench are carried ahead by simultaneous blasts. The same kind of machines and steel are used for drilling as in drifting, but the machine is mounted on a light tripod without weights instead of on a bar.

About five hours of drilling is done per shift; the machines drill from 5 to 6 ft. per hour and average about 25 to 30 ft. per shift. In full-sized stopes the burden is approximately 1 ton per foot of hole, but is less in the breast holes and more in the bench holes. Usually one miner works in a stope, but occasionally there are two miners using two machines. The miners are paid by contract according to the number of cars (2.5 tons) trammed from the stope; the size of the stope and the hardness and toughness of the ore are taken into account in setting the price. Contracts are charged with all explosives, carbide, picks, shovels, and other hand tools, but are not charged for compressed air or for drills and drill steel.

The ore breaks in large pieces, so that a good deal of sledging and secondary blasting are required. The largest pieces are blockholed for blasting, and the flatter pieces are bulldozed. This work is done by the miner as part of his contract.

Distribution of Drill Steel—Each contract has its own steel, stamped on the shank with numerals ½-in. high, and receives each day the same steel sharpened that it sent up dulled the day before. The sharpened steel is sorted after being tempered and is made up in bundles of 100 to 125 lb., held together by hardwood wedges in a welded iron ring 4½ in. in diameter. The wedges and rings are used over and over again, but one new wedge is used in each bundle, and on that wedge the contract number is written with blue chalk. The dulled steel is not sorted. Sharp steel is delivered by the cage-riders at the proper levels, and is carried to the working places by the miners. Dull steel is handled by the same men, but in the reverse order. The average consumption of drill steel in 1928 was 0.105 lb. per ton of ore and rock produced.

Ore Partly Loaded by Hand

In stopes where there is much rock to sort out and in stopes the life of which will be short, it is better to load the ore by hand than mechanically. The standard car is made entirely of steel, is of the end-dump type with the body rigidly fastened to the truck, and is equipped with 14-in. roller-bearing wheels. The car stands 37½ in. high, weighs 1,400 lb. empty and 7,000 lb. loaded, and carries a load of 5,600 lb., or 2½ tons; it has a capacity of 37 cu.ft. Mine track is of 24-in. gage and is laid with 20-lb. rails.

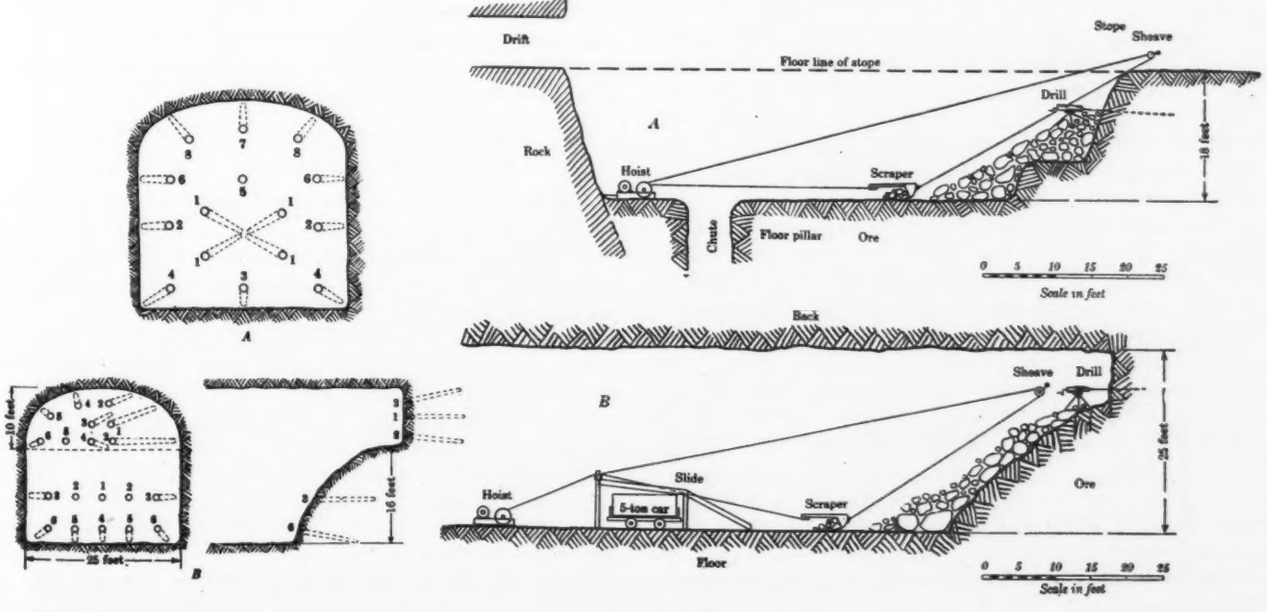
In most places the tram is short, and the car is dumped into a chute by means of a cradle. Where the tram is long the trammers are supplied with a 1½-ton storage-battery locomotive. The trammers (loaders or shovelers) work in pairs on contract; they are paid a certain price for filling the car and 1c. for every 45 ft. trammed. When a locomotive is provided, only the filling price is paid. The contract basis is as follows:

Price per Car (2½ Tons)

	Large Piles	Stopes	Drifts	Chutes
Hand-filling	$0.47	$0.52	$0.57	....
Chute filling	....	....	....	$0.20
Tramming (per 45 ft.)	.01	.01	.01	.01
Minimum from chute	....	....	....	.28
Minimum by hand	.55	.60	.65	....

Note: Prices are about 10 per cent higher for wet places. Prices for filling vary with the type of chute.

Figs. 5 and 6—In Fig. 5, at left, "A" is a drift round and "B" is a breast stope round. In Fig. 6, at right, "A" shows a method of removing floor pillars, and "B" a method of breast stoping.



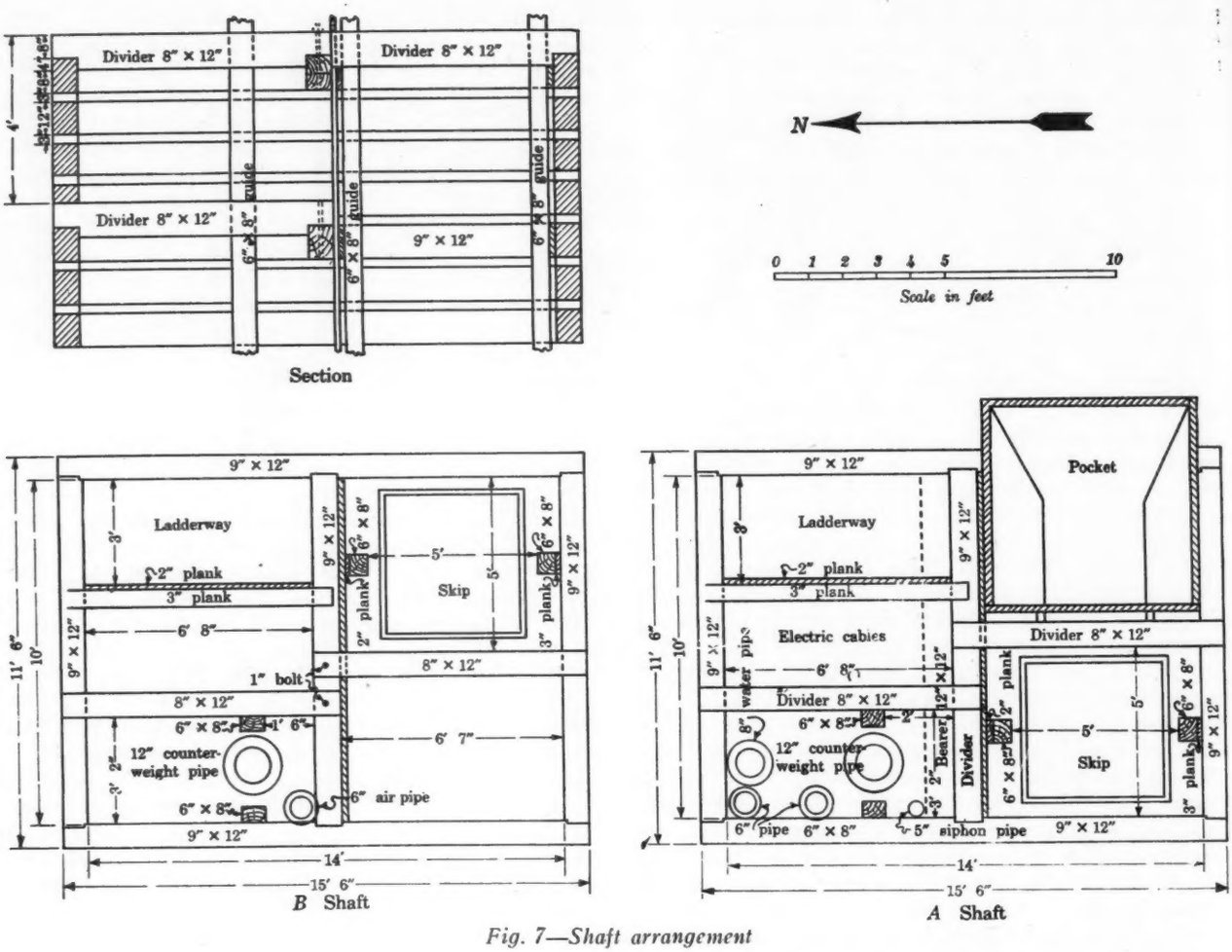


Fig. 7—Shaft arrangement

Loading by Scrapers Into Chutes—On sublevels and where a chute is within reach the broken ore is moved from the breast to the chute by scrapers (Fig. 6A). These scrapers are all of one design, 48 in. wide and 7 ft. long, of the hoe type, and weigh 1,500 lb. Blade, side plates and draw-head are made of manganese steel. The blade is the only part that wears appreciably, and this has a life of 6,000 to 10,000 tons, averaging about 8,000 tons.

The scraper is hauled by a 25-hp. double-drum electric hoist, with planetary transmission, using $\frac{5}{8}$-in. extra plow-steel wire rope with independent wire-rope center (Fig. 9). Its motor is of the 25 hp., 900 r.p.m., 440 volts a.c., 3 phase, 60 cycle, squirrel-cage type. A complete scraping outfit, exclusive of electric cable, costs $1,150 set up in place.

One miner and one scraper man constitute the crew in a stope. The scraper man helps the miner in setting up and tearing down his machine, and the miner helps the scraper man rig up his scraper blocks. The miner is paid by the car trammed from the chute and in most places the scraper man is paid by the day. This system is gradually being changed to a contract basis for both men. Contract prices per car ($2\frac{1}{2}$ tons) dumped in the chute vary from 90c. to $1.50, including both breaking and scraping.

Loading Cars by Aid of Scrapers—In a few places semi-portable steel scraper-slides are used to fill main haulage cars (Fig. 6B). The scraper slides are not mounted on wheels, and must be taken apart to be moved. The hoist is not mounted on the slide, but is set up at one side of the track, and the ropes pass through blocks hung from the back or from the framework of the slide. Both hoist and scraper are of the same type as used in the stopes, previously described, and the crew in the stope is also the same—one miner and one scraper man.

Main-line cars stand 56 in. high and hold 76 cu.ft. ($5\frac{1}{2}$ tons). Exclusive of switching, the time required to load a car is six minutes. Including delays and switching, four cars (22 tons) are loaded in an hour. The number of places using this equipment is being increased. The slide weighs 3,660 lb. and costs $360.

Underground Transportation by Storage Battery or Trolley Locomotives

Trolley locomotives and large cars are used on three levels—the eighth, tenth and fifteenth. On most of the other levels storage-battery locomotives are used with 2.5 ton end-dump cars. There are six trolley locomotives and eleven storage-battery locomotives in the mine. The storage-battery locomotives vary in weight from $1\frac{1}{2}$ to 4 tons. They are all 24-in. gage, and all but two are equipped with Edison A4 cells. The trolley locomotives are all $6\frac{1}{2}$-ton, 250-volt, double-motor machines. Mine track is 30-in. gage, laid with 40-lb. rails.

The cars are of rocker-dump design and hold 76 cu.ft. (5.5 tons) of ore (Fig. 10). Both locomotives and cars are equipped with automatic couplers. These cars are pulled to the shaft in trains of five or six, and the loaded cars are left at the shaft to be spotted by a tugger hoist,

while the locomotive returns "inside" with a train of empties. An automatic switch turns the empties onto a siding as soon as the cars are dumped, in order to leave the main line clear for the next train of loads. No uncoupling is necessary except at the locomotive.

Cars are dumped one at a time into the shaft pocket, which has a capacity of only one car and acts merely as a chute through which the contents of the car are discharged into the skip. The loading time is ten to twelve seconds. No skip tenders are employed; the cars are dumped by two skip riders who go from level to level dumping the loaded cars that have been left on the sidings. The wages of these men are charged to tramming.

The standard chute in use underground is the Alaska-Treadwell finger chute slightly improved (Fig. 8). For 20 ft. above the chute the raise is put up at an angle of 45 deg. and is then turned to right or left or upward, so that the velocity of the ore in falling will be checked by the elbow thus formed. The chute itself is made of 3-in. hemlock plank and is lined with $\frac{3}{8}$-in. boiler plate. Chute fingers are made of 4x6-in. fir dressed on all sides to $3\frac{1}{2}$x$5\frac{1}{2}$ in., and are painted before being taken underground. The strap forming the hinge at the top is of $\frac{3}{8}$x4-in. soft steel, and the wearing shoe at the lower end of the short member is a manganese-steel casting. The apron to catch the dribblings that pass through the fingers is made of steel. As all sizes are standardized throughout the mine, the various parts can be made up in the mine shops in quantity at considerable reduction in cost.

After a raise has been worn smooth, the time of loading at the chute is short; a $2\frac{1}{2}$-ton car can be loaded in 15 to 20 seconds and a 5-ton car in less than half a minute. The efficiency of these chutes has been a large factor in maintaining a large production.

Average Extraction 72 Per Cent

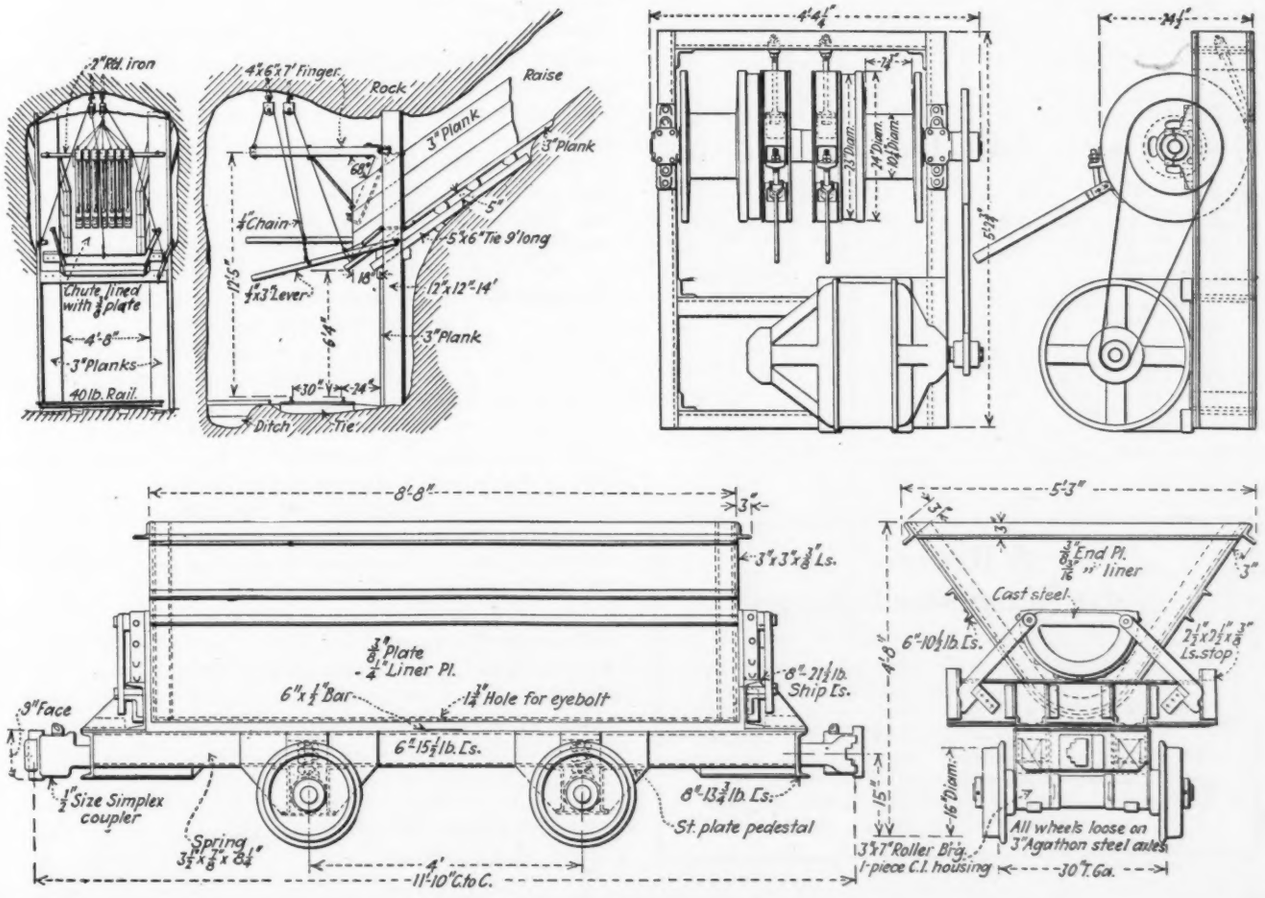
One of the characteristics of the room-and-pillar method of mining is that a large percentage of the ore reserves is left in the mine as floors. While the breast stopes are advancing, floors on the line of haulage cannot be mined unless provision is made to transfer the ore to lower levels. The extraction in wide bodies is approximately 65 per cent, but in narrow orebodies with strong walls standing nearly vertical it may be as high as 90 per cent. Average for the mine has been 72 per cent. The percentage of extraction can be worked out very closely by a checker-board system, determining the percentage of ore mined in the stopes and pillars and also in the floors, and combining the percentages. Results check very closely with actual production.

Ventilation and Fire Hazards

Only natural ventilation is needed. The downcast is through an adjoining idle mine, with which there is a connection from the eighth level in shaft *A*, and the upcast is through both the hoisting shafts. With a little care there is practically no trouble in distributing the fresh air to all parts of the mine.

Although both the shafts are wet and there is little timber in the mine, a complete system of fire doors has been established, so that the incoming air can be instantly cut off and the flow of air between the two shafts can

Figs. 8, 9 and 10—Fig. 8, upper left, shows the design of an improved Alaska Treadwell finger chute adopted as standard. Fig. 9, upper right, covers the design of a planetary scraper hoist. Fig. 10, below, is a sketch of the 76-cu.ft. rocker-dump ore car used on the main-line tracks.



be instantly stopped by merely turning compressed air into the pipe line leading to the door latches. On each level at the shaft, in each headframe on the surface, and at the downcast airway there is a valve for this purpose. First-aid and fire-helmet crews receive regular monthly training from the company's central organization and from the Bureau of Mines Mine Rescue Car when it visits the district.

Summary of Costs

Number of mine: No. 1 — Period covered: Year 1928.
Long tons ore hoisted during period: 420,000
Mining method: Open stopes with pillar support.

Underground Costs Per Long Ton of Ore Hoisted

Development:	Labor	Supervision	Compressed Air, Drills and Steel	Power	Explosives	Timber	Other Supplies	Total
In ore	$0.027	$0.004	$0.015	.....	$0.009	$0.003	$0.009	$0.067
In rock	.080	.009	.030	.....	.022	.003	.007	.151
Mining	.514	.028	.104	$0.006	.105	.002	.011	.770
Transportation (underground)	.142	.007	.....	.042	.....	.005	.048	.244
General underground expense	.075	.007	.004	.060	.....	.....	.034	.180
Totals	$0.838	$0.055	$0.153	$0.108	$0.136	$0.013	$0.109	$1.412

Costs in Units of Labor, Power and Supplies

	Development	Mining	Total
A. Labor (man-hours per long ton):			
Breaking (drilling and blasting)	$0.112	$0.342	$0.454
Timbering and filling	.022	.051	.073
Mucking	.060	.310	.370
Haulage and hoisting	.017	.220	.237
General	.032	.096	.128
Supervision	.014	.037	.051
Total labor underground	$0.257	$1.056	$1.313
Average tons per man per shift	.....	.....	6.10
Labor, percentage of total cost	.....	.....	65.0
B. Power and Supplies:			
Explosives (pounds per long ton)	$0.196	$0.705	$0.901
(Kind and grade)	60% l.f. Ammonia	50% l.f. Ammonia	.....
Timber (b.m.)	$0.221	$0.224	$0.445
Power (kilowatt-hours per long ton):			
Air compression	.....	4.33	.....
Hoisting	.....	2.04	.....
Pumping	.....	4.02	.....
Scrapers and lights	.....	0.41	.....
Haulage and lights	.....	.76	.....
Total	.....	$11.56	.....
C. Percentage of Total Cost	15.4	84.6	100.0

Details of Costs in Units of Labor, Power, and Supplies

	Drifting 8 x 8 ft.	Raising 6 x 6 ft.
Size of excavation		Chutes only
Timbered or not	Not	Hard
Physical properties of rock and ore	Hard	
A. Labor (man-hours per foot):		Total Development
Breaking		7.11
Timbering		1.40
Mucking		3.81
Haulage and hoisting		1.08
Supervision		.81
Total labor		$14.21
Feet per man-shift of eight hours		0.5634
B. Power and Supplies per Foot:		
Explosives (pounds per foot)		12.5
Timber (board feet)		13.4
Total power (kilowatt-hours)		62
C. Percentage of Total Cost:		
Labor		62
Supplies		38

A Review of the Magnesite Industry

IN A FORTHCOMING ISSUE of *E.&M.J.*, Mr. J. M. Hill will discuss the status of the magnesite industry in the United States, pointing out the principal avenues in which it is likely to expand, and also those from which little can be hoped. Valuable data on world and United States production and consumption over a lengthy period are included. In a subsequent article, Mr. Hill will discuss the limestone industry of the Pacific Coast.

Structural Characteristics of Zinc Ferrites—Coarse Sand Flotation

A STUDY of the structural characteristics of zinc ferrites is being conducted at the Intermountain Experiment Station, U. S. Bureau of Mines, Salt Lake City, Utah, in co-operation with the department of mining and metallurgical research, University of Utah. Under the binocular microscope the ferrites are of a red to reddish-brown color, and may be divided into two classes, dependent on a marked difference in their properties of magnetic susceptibility. Some of the ferrite grains are strongly magnetic and others are only slightly so. The grains that are strongly attracted by a magnet have a noticeably lustrous surface, compared with those that are slightly magnetic, and also appear to be less porous. The difference in magnetic susceptibility of the two types of ferrites may be judged from the fact that those grains having the lustrous surface will jump to a magnetic point, but those having a dull surface will adhere to the pointer only when touched.

The study of thin sections yielded no information except to indicate that ferritization progressed from the outside of the grain to the center. Comparisons between the ferrites and the minerals franklinite and zincite suggested that the ferrites examined might be a mixture of franklinite and zincite. In the determination of the iron-zinc ratio in ferrites, the zinc oxide that is not combined with iron is removed by leaching with Low's solution and the zinc-iron determination made on the residue. Solubility tests showed that the mineral zincite was completely soluble in Low's solution and that franklinite was not. This would indicate that if the softer, brownish-gray component in the ferrites is zincite it would be removed by leaching with Low's solution and that the constituent remaining would possess the characteristics of franklinite. This being the case the leached ferrites are probably quite spongy, owing to removal of the zincite, and this feature would have a bearing on further treatment to increase their rate of solubility.

To obtain further data on the relationship between iron oxide and zinc oxide in ferrites, leached ferrites are being briqueted for microscopic study. All the results heretofore obtained by chemical and X-ray study of ferrites indicate strongly that a definite compound is formed, although little is known of the mechanism of formation. The present microsopic study will throw additional light on this phase of the subject and should be of value in devising a further treatment of ferrites. At present, marmatite ores (sphalerites containing 10 per cent or more iron) are not accepted by the zinc smelters, because of the amount of ferrite formed when they are roasted. However, the supply of low iron sphalerites will eventually become exhausted and the marmatite ores must be treated in order to maintain the supply of zinc. Hence the importance of obtaining all the data possible on ferrites.

Considerable success has been achieved in the treatment of ores by the coarse sand flotation process at the Moscow (Idaho) field office of the U. S. Bureau of Mines, in co-operation with the University of Idaho and the Idaho Bureau of Mines and Geology. The probable saving in grinding cost of such practice over present fine grinding is an appreciable item. The new procedure involves middling flotation or table recovery of coarse mineral and middling.

Annual Consumption of Reagents Used in Flotation

By A. M. GAUDIN

Associate Professor of Metallurgical Research, University of Utah
Salt Lake City, Utah

BESIDES *providing a valuable gage of the metallurgical efficiency of milling plants, reagent statistics also indicate the trend in flotation practice. For these reasons, particularly, this article, which was prepared under a cooperative agreement between the U. S. Bureau of Mines and the University of Utah, and which is printed by permission of the Director of the U. S. Bureau of Mines, should be of considerable benefit to the mining industry.*

A STUDY of the consumption of reagents used in flotation gives useful data as to the market which employment of the flotation process creates for the manufacturers of the necessary chemicals and oils, and furnishes a useful clew to the trends in flotation practice influencing the choice of reagents used and the extent to which new reagents are displacing less suitable older reagents. In the present investigation an attempt has been made to cover both of these phases of the consumption of reagents in flotation. Unfortunately, however, the data collected in the various districts have not been equally informative; some operators have reported very completely both the consumption of reagents and the metallurgical results obtained therewith, whereas others were apparently unable to supply these figures in sufficient detail to meet the investigation's requirements.

Table I gives the tonnage of ore treated by flotation, as reported. This table shows that flotation has been most largely used in the concentration of copper ores, next in complex lead-zinc ores, followed by lead ores, zinc ores, miscellaneous ores, and copper-iron ores.

Table I—Tons of Ore Treated by Flotation, and Reported in 1927

Number of Concentrates Made	Ores Treated	Tons
One	Copper ores	40,881,168
	Lead ores and copper-lead ores	2,596,314
	Zinc ores	1,708,388
	Miscellaneous ores	561,886
Two or three	Copper-iron ores	497,238
	Lead-zinc (including lead-zinc-iron and lead-copper ores from which several concentrates are made)	3,827,856
Total		50,073,450

The apparently much greater use of flotation in treating copper ores is explained, in part, by the comparatively low grade of the ores treated. Comparison of Table I with the tonnage treated by flotation in 1926 as given in Serial 2852 of the U. S. Bureau of Mines indicates that there was a small decrease in the tonnage of the copper ores treated, but a large increase in the complex lead-zinc ores and the zinc ores treated. Total tonnage treated, including all kinds of ores, was substantially the same. This may be the result of a proportionally small shrinkage in the tonnage of low-grade copper ores treated, or of the fact that the production reports on which this study is based are less complete.

Table II gives the total quantity of reagents used, as reported in 1927.

Table II—Reagent Consumption in the Treatment by Flotation of All Ores

	Pounds
I. Frothers:	
Pine oils	5,064,320
Cresols	1,379,959
Amines	138,092
Alcohols	780
Totals	6,583,151
II. Collectors:	
1. Oils:	
Coal-tar creosotes and coal tar	2,655,352
Wood-tar creosotes	409,528
Crude oils and petroleum products	141,382
Blast-furnace oils	159,106
Water-gas oils and tars	37,338
Miscellaneous oils	64,241
Reconstructed oils (except Aerofloat and phosphocresylic acids)	42,046
Total	3,508,993
2. Chemicals:	
Ethyl xanthates	3,319,639
Higher xanthates (amyl and butyl)	304,604
Di-thio-phosphoric acids	1,932,996
Thio-carbanilid	145,791
Alpha-naphthylamine	6,035
Thio-ureas	16,040
Oleic acid	41,690
Total	5,766,795
III. Acids and Alkalis:	
1 Acids:	
Sulphuric	9,748,729
Hydrochloric	500
Total	9,749,229
2. Alkalis:	
Sodium carbonate (soda ash)	5,110,442
Sodium bicarbonate	85,075
Sodium hydroxide	16,350
Lime	169,926,145
Barium carbonate	16,050
Cement	1,611,946
Total	176,766,008
IV. Other Inorganic Reagents:	
1. Sulphidizing reagents	
Sodium sulphide	4,651,463
Calcium and barium sulphides	439,322
Total	5,090,785
2. Activating reagents:	
Copper sulphate	5,908,900
3. Depressing reagents:	
Cyanides	1,616,296
Sodium sulphite	532,318
Sodium silicate	2,519,151
Zinc sulphate	2,019,371
Sodium dichromate	46,625
Tri-sodium phosphate	25,151
Total	6,758,912
4. Miscellaneous reagents:	
Aluminum sulphate	504
Sulphur	4,314
Calcium chloride	265,550
Sodium chloride	101,576
Total	371,944
V. Protective organic colloids:	
Glue	7,556
Starch	2,100
Total	9,656

Summary of Table II (Preceding)

Reagents	Pounds	Total Pounds
Frothers	.....	6,583,151
Collectors:		
1. Oils	3,508,993	.....
2. Chemicals	5,766,795	.....
		9,275,788
Acids and Alkalis:		
1. Acids	9,749,229	.....
2. Alkalis	176,766,008	.....
		186,515,237
Other Inorganic Reagents:		
1. Sulphidizing	5,090,785	.....
2. Activating	5,908,900	.....
3. Depressing	6,758,912	.....
4. Miscellaneous	371,944	.....
		18,130,541
Protective organic colloids	.....	9,656
Grand total		220,514,373

The term "cresols" as used in this and other tables in this report covers all such compounds as phenols, cresols, xylenols, and cresylic acid (which is largely made of xylenols), as well as the part of so-called "phosphocresylic acid" or Aërofloat which has not reacted with the added phosphorus pentasulphide. The term "amines" covers such compounds as aniline, toluidines, xylidines, and other amines, with the exception, however, of amines having collecting properties as well, such as alpha-naphthylamine. The term alcohol includes all sorts of alcohols besides wood and grain alcohols. Collectors are classified into oils and chemical compounds. Although Aërofloat (which is identical with phosphocresylic acid) is an oil in appearance, its chemical composition is rather definitely known; it is made up of cresylic acid (xylenols) that has not reacted and of a reaction compound of cresylic acid with phosphorus pentasulphide, which is stated to be a di-cresyl-di-thio-phosphoric acid. Accordingly, phosphocresylic acid has been considered as being part (35 per cent) frother, and part chemical collector (65 per cent). The collector part of Aërofloat is included under the caption, "di-thio-phosphoric acids." Coal-tar creosotes, wood creosotes (including both hardwood and pine-tar creosotes), crude oils and petroleum products, blast-furnace oils, water-gas oils, and reconstructed oils of indefinite composition are the main classes of oils that were used in 1927. The rest of the oils are included under the heading "miscellaneous oils." Of the chemical collectors the most abundantly used in 1927 were the xanthates; potassium and sodium ethyl xanthates were used in large quantity; and higher xanthates, particularly amyl and butyl, were also employed at some plants. Thiocarbanilid (or diphenylthio-urea), alpha-naphthylamine, thio-ureas, and oleic acid were used in minor amounts. Oleic acid, although oily, is included under the heading of chemical compounds because its composition is definitely known.

Of the acids and alkalis, sulphuric acid, sodium carbonate (soda ash), and lime were used in large amounts. At some plants cement was substituted for lime or soda ash. A large and much-increased quantity of inorganic reagents, other than acids or alkalis, was used in 1927. They are classified under the headings of sulphidizing reagents, activating reagents, depressing reagents, and miscellaneous reagents. Sulphidizing reagents and some depressing reagents, such as sodium silicate, give a strong alkaline reaction on hydrolysis—that is, on reaction with water. In other words, besides possessing certain sulphidizing and depressing properties, they may be acting in place of alkali; they seem to have been used as such in some instances, as in the treatment of certain copper ores. From Table II it appears that the total reagent consumption was about 220,500,000 lb., an increase of about 20,000,000 lb., or 10 per cent, over the figures for 1926.

Table III distributes the consumption of these reagents according to the various classes of reagents in 1925, 1926, and 1927. Comparison of the data for 1926 and 1927 brings out the fact that a 2 per cent increase in frother consumption occurred in 1927 over 1926; a 40 per cent decrease in collecting oils, and a 38 per cent increase in chemical collectors; a large percentage increase in acid consumption; and a large tonnage increase in the consumption of alkaline reagents, as well as substantial increases in the consumption of depressing and activating reagents. A small decrease was noted in the consumption of sulphidizing reagents, which may be attributed to a decrease in the use of sulphidizing reagents as alkaline reagents, and to their replacement by less costly alkaline reagents.

The table shows strikingly the rapid replacement of collecting oils by chemical collectors, the increased use of alkaline circuits (with the exception of an increase in the use of acid in some selective two-product copper-iron flotation plants), and the very marked increase in depres-

Table III—Comparison of Reagent Consumption for the Years 1925, 1926, and 1927

	1925(a)	1926 (b)	1927	Increase, 1927 Over 1926, Per Cent
Thousands of tons treated	45,490	50,889	50,073	— 1.3
Reagents in 1,000 pounds:				
Frothers	4,835	6,464	6,583	+ 2
Collectors: 1. Oils	19,439	5,870	3,509	—40
2. Chemicals	4,133	4,179	5,767	+ 38
Acids	40,028	4,540	9,749	+115
Alkalis	3,733	166,889	176,766	+ 6
Sulphidizing reagents	5,532	7,355	5,091	—31
Activating reagents	1,544	3,583	5,909	+ 65
Depressing reagents	1,660	2,432	6,759	+178

(a) Varley, Thomas: Report of Investigations, Serial 2777, Bureau of Mines, Oct., 1926, 10 pp.
(b) Varley, Thomas: Report of Investigations, Serial 2852, Bureau of Mines, Jan., 1928, 4 pp.

Table IV—Reagent Consumption in the Treatment by Flotation of Copper Ores

(Tons treated, 40,881,768; number of plants, 25)

Reagents	Amount, Pounds	Pounds per Ton	Number of Plants
I. Frothers:			
Pine oils	4,117,756	0.101	24
Cresols	954,000	.023	8
Amines	55,409	.001	2
	5,127,165	.125	25
II. Collectors:			
1. Oils:			
Coal-tar creosotes	1,163,567	.028	5
Wood-tar creosotes	8,203	.....	1
Crude oils and petroleum products	83,255	.002	1
Blast-furnace oils	159,106	.004	2
Miscellaneous	1,200	.....	1
	1,415,331	.034	10
2. Chemicals:			
Di-thio-phosphoric acids	1,769,431	.043	7
Ethyl xanthates	2,107,505	.052	20
Butyl and amyl xanthates	304,604	.007	1
Thio-carbanilid	19,834	.001	3
Oleic acid	41,690	.001	1
	4,243,064	.104	23
III. Acids and Alkalis:			
1. Acids:			
Hydrochloric	500	.....	1
2. Alkalis:			
Sodium carbonate	328,726	.008	2
Lime	163,688,849	4.004	19
	164,018,075	4.012	22
IV. Other inorganic reagents:			
1. Sulphidizing reagents:			
Sodium sulphide	4,004,097	.098	1
3. Depressing reagents:			
Cyanides	739,465	.018	8
Sodium silicate	687,696	.016	1
Trisodium phosphate	25,151	.001	1
	5,456,409	.133	10
Summary:			
Frothers	5,127,165	.125	25
Collectors:			
1. Oils	1,415,331	.034	10
2. Chemicals	4,243,064	.104	23
Acids and alkalis	164,018,075	4.012	22
Sulphidizing reagents	4,004,097	.098	1
Depressing reagents	1,452,312	.035	10
Total	180,260,044	4.408	25

Table V—Reagent Consumption in the Treatment by Flotation of Copper-Iron Ores

(Tons treated, 497,238; number of plants, 3)

Reagents	Amount, Pounds	Pounds per Ton	Number of Plants
I. Frothers:			
Pine oils	123,132	0.248	3
II. Collectors:			
1. Oils:			
Coal-tar creosotes	121,604	.245	2
Reconstructed oils	1,500	.003	1
2. Chemicals:			
Ethyl xanthates	50,550	.102	2
III. Acids and Alkalis:			
1. Acids:			
Sulphuric	9,745,325	19.599	2
2. Alkalis:			
Lime	840,550	1.690	3
Cement	1,611,946	3.242	1
IV. Other Inorganic Reagents:			
Activating reagents:			
Copper sulphate	69,083	.139	1
3. Depressing reagents:			
Cyanide	4,887	.010	1
Total	12,568,577	25.278	3

Table VI—Reagent Consumption in the Treatment by Flotation of Sulphide Lead Ores; Sulphide Lead-Zinc Ores in Which No Zinc Product Is Made; Sulphide Lead-Copper Ores in Which One Product Only Is Made, and Oxidized Lead Ores in Which One Product Is Made.

(Tons treated, 2,596,314; number of plants, 29)

Reagents	Amount, Pounds	Pounds per Ton	Number of Plants
I. Frothers:			
Pine oils	203,276	0.078	25
Cresols	212,521	.082	8
Amines	2,171	.001	2
	417,968	.161	27
II. Collectors:			
1. Oils:			
Coal-tar creosotes	192,852	.074	17
Wood-tar creosotes	209,965	.081	8
Miscellaneous	43,858	.017	3
Reconstructed oils	39,196	.015	1
	485,871	.187	24
2. Chemicals:			
Di-thio-phosphoric acids	78,363	.030	7
Ethyl xanthates	222,852	.086	24
Thio-carbanilid	12,676	.005	2
	313,891	.121	24
III. Acids and Alkalis:			
1. Acids:			
Sulphuric	819	.....	1
2. Alkalis:			
Sodium carbonate	478,991	.185	7
Sodium bicarbonate	5,975	.002	1
Lime	1,411,831	.544	7
Barium carbonate	16,050	.006	1
	1,913,666	.737	13
IV. Other Inorganic Reagents:			
1. Sulphidizing reagents:			
Sodium sulphide	448,665	.173	9
Barium sulphide	435,382	.168	1
	884,047	.341	10
2. Activating reagents:			
Copper sulphate	5,925	.002	3
3. Depressing reagents:			
Cyanides	147,223	.057	8
Sodium silicate	71,468	.028	4
Zinc sulphate	279,648	.108	7
	498,339	.193	12
4. Miscellaneous:			
Aluminum sulphate	504	.....	1
Sulphur	4,314	.002	1
	4,818	.002	2
Summary:			
Frothers	417,968	.161	27
Collectors:			
1. Oils	485,871	.187	24
2. Chemicals	313,891	.121	24
Acids and alkalis	1,913,666	.737	13
Sulphidizing reagents	884,047	.341	10
Activating reagents	5,925	.002	3
Depressing reagents	498,339	.193	12
Miscellaneous inorganic reagents	4,818	.002	2
Total	4,524,525	1.744	29

sing and activating reagents resulting from the expansion in selective, two-product lead-zinc flotation operations.

Table IV gives a detailed statement of the consumption of reagents in the treatment of straight copper ores, and Table V shows the amount of reagents consumed in the treatment of copper-iron ores. Table IV brings out the fact that lime constitutes over 90 per cent of the total reagent consumption in terms of weight; in terms of cost, as well, it is apparent that lime must be one of the largest items. The amount of lime consumed averages a little over 4 lb. per ton of ore, whereas there is no other reagent averaging more than $\frac{1}{10}$ lb. per ton of ore. Pine oils are the most extensively used frothers; xanthates and di-thio-phosphoric acids the most extensively used collectors; cyanide and sodium silicate, the most extensively used depressing reagents.

Comparison of Table V with Table II indicates that substantially all of the acid employed in flotation is used in three plants making a selective copper-iron flotation yielding two concentrates. Although it is not definitely known that the acid is used in floating the iron, it seems likely, inasmuch as no acid is used in selective copper-iron flotation where a copper product only is made, and as the use of acid to help float iron has been reported in the press in connection with some Canadian installations. It is also seen from Table V that a substantial amount of alkaline substances, lime and cement, are used, probably in retarding flotation of the iron minerals during the copper floating stage.

Table VI includes straight lead ores; lead-zinc ores from which but one product is made, and in which lead is the dominant available constituent; and lead-copper ores, from which one product only is made. Oxidized lead ores are also included in this table. By comparing Table VI with Table IV it is apparent that less lime is used in lead ores than in copper ores. This may result, in part, from the fact that there is less necessity for depressing pyrite in lead ores than in copper ores; it may also be attributed to the fact that upon partial oxidation lead ores become less acid than copper ores, so that there is no need for such a large amount of alkaline reagents to neutralize the acid salts resulting from oxidation. Extensive use of pine oils, cresols, wood-tar creosotes, and xanthates is indicated in this table, as well as the substantial use of sulphidizing agents, in connection with the flotation of the oxidized lead ores.

Table VII details the reagent consumption in the flotation of zinc ores. The most striking feature is the large and general use of copper sulphate and the large but localized use of sodium silicate. The large consumption of copper sulphate in the flotation of straight zinc ores is natural when it is considered that sphalerite is almost universally floated as a copper-sulphide-surfaced mineral. When compared with straight lead ores, it is apparent that proportionally more chemical collectors and less of the oils are used in the flotation of zinc ores.

The most interesting, perhaps, of all the ores included in this study are the complex lead-zinc ores. These ores generally contain substantial amounts of pyrite and pyrrhotite, which is discarded, although in some instances it is collected as a third concentrate. Both of the lead-zinc ores in which two products are made, and the lead-zinc-iron ores in which three products are made, are included in Table VIII. The most striking features that are brought out by this table are the large consumption of alkaline reagents as compared with the consumption of the same reagents in the flotation of lead ores and of zinc ores; the large consumption of cyanides, zinc sulphate, sodium sulphide, and the comparatively large amount of collectors, both oils and chemicals, that apparently are needed. Larger consumption of alkaline re-

agents can perhaps be ascribed to the fact that the lead-zinc and lead-zinc-iron ores contain more sulphide minerals than straight lead or straight zinc ores, and that therefore there is more material to oxidize and a larger quantity of acid salts requiring neutralization is formed. The larger per-ton consumption of copper sulphate is no doubt caused by the fact that deadened sphalerite is more difficult to float than sphalerite that has been neither deadened nor activated, and therefore calls for larger amounts of activating reagents.

Table IX gives the reagent consumption for miscellaneous ores.

Table X summarizes the results of the preceding six tables, giving the total reagent consumption by classes of reagent for each class of ore, as well as the per-ton consumption of the same reagents by these ores.

Unfortunately, no complete data were available as to the metallurgical results obtained through the use of the reagents listed in Table X; from the data that were available the following have been determined:

1. Twenty Intermountain copper flotation plants treated 39,173,000 tons of ore, producing 2,544,500 tons of concentrate of a grade averaging 19.53 per cent copper, the ratio of concentration being 15.4:1.

2. Twenty-two Intermountain lead flotation plants treated by straight flotation 931,000 tons of ore and produced 68,610 tons of lead concentrate, averaging 33.9 per cent lead. The ratio of concentration was 13.6:1. The lead concentrate contained 0.51 per cent copper and 41.8 oz. of silver per ton.

Table VII—Reagent Consumption in the Treatment by Flotation of Sulphide Zinc Ores

(Tons treated, 1,708,388; number of plants, 42)

Reagents	Amount, Pounds	Pounds per Ton	Number of Plants
I. Frothers:			
Pine oils	190,061	0.111	35
Cresols	123,247	.072	29
Amines	9,276	.006	11
Alcohols	480	.....	2
	323,064	.189	42
II. Collectors:			
1. Oils			
Coal-tar creosotes	116,715	.069	23
Wood-tar creosotes	17,805	.010	1
Crude oils	3,788	.002	2
Miscellaneous oils	9,201	.005	5
	147,509	.086	27
2. Chemicals			
Di-thio-phosphoric acids	4,530	.003	9
Ethyl xanthates	189,113	.111	37
Thio-carbanilid	22,775	.013	1
Alpha-naphthylamine	6,035	.003	10
	222,453	.130	39
III. Acids and Alkalis:			
1. Acids			
Sulphuric	2,585	.001	3
2. Alkalis			
Sodium carbonate	795,320	.468	7
Sodium hydroxide	800	.....	1
Lime	291,660	.170	11
	1,090,365	.639	14
IV. Other Inorganic Reagents:			
2. Activating reagents			
Copper sulphate	1,379,750	.808	42
3. Depressing reagents			
Cyanide	268	.....	2
Sodium sulphite	407	.....	1
Sodium silicate	1,481,805	.868	4
Zinc sulphate	654	.....	1
Sodium dichromate	46,625	.027	1
	1,529,759	.895	8
4 Miscellaneous reagents			
Sodium chloride	1,500	.001	2
Summary:			
Frothers	323,064	.189	42
Collectors:			
1. Oils	147,509	.086	27
2. Chemicals	222,453	.130	39
Acids and alkalis	1,090,365	.639	14
Activating reagents	1,379,750	.808	42
Depressing reagents	1,529,759	.895	9
Miscellaneous inorganic reagents	1,500	.001	2
Total	4,694,400	2.748	42

Table VIII—Reagent Consumption in the Treatment by Flotation of Lead-Zinc Ores and Lead-Zinc-Iron Ores

(Tons treated, 3,827,856; number of plants, 28)

Reagents	Amount, Pounds	Pounds per Ton	Number of Plants
I. Frothers:			
Pine oils	411,286	0.107	25
Cresols	89,441	.024	20
Amines	70,936	.018	5
	571,663	.149	28
II. Collectors:			
1. Oils			
Coal-tar creosotes	1,052,621	.275	18
Wood-tar creosotes	162,360	.042	9
Crude oils and petroleum products	2,266	.001	3
Miscellaneous	9,982	.003	1
	1,227,229	.321	21
2. Chemicals			
Di-thio-phosphoric acids	80,672	.021	10
Ethyl xanthates	715,385	.187	25
Thio-carbanilid	90,506	.024	5
Thio-ureas	16,040	.004	1
	902,603	.236	25
III. Acids and Alkalis:			
2. Alkalis			
Sodium carbonate	3,216,850	.840	18
Sodium bicarbonate	79,100	.021	1
Sodium hydroxide	15,550	.004	1
Lime	3,631,236	.948	17
	6,942,736	1.813	26
IV. Other Inorganic Reagents:			
1. Sulphidizing reagents			
Sodium sulphide	198,701	.052	3
Barium and calcium sulphides	3,940	.001	2
	202,641	.053	4
2. Activating reagents			
Copper sulphate	4,436,662	1.159	27
3. Depressing reagents			
Cyanides	700,973	.183	18
Sodium sulphite	520,911	.136	3
Sodium silicate	278,182	.073	4
Zinc sulphate	1,738,721	.454	16
	3,238,787	.846	26
4. Miscellaneous			
Calcium chloride	265,550	.069	1
Sodium chloride	100,076	.026	2
	365,626	.095	3
V. Protective Organic Colloids:			
Starch	2,100	.001	1
Glue	7,556	.002	1
	9,656	.003	1
Summary:			
Frothers	571,663	.149	28
Collectors:			
1. Oils	1,227,229	.321	21
2. Chemicals	902,603	.236	25
Alkalis	6,942,736	1.813	26
Sulphidizing inorganic reagents	202,641	.053	4
Activating inorganic reagents	4,436,662	1.159	27
Depressing inorganic reagents	3,238,787	.846	26
Miscellaneous inorganic reagents	365,626	.095	3
Protective organic colloids	9,656	.003	1
Total	17,897,603	4.675	28

(a) Three are lead-zinc-iron, and two lead-zinc containing large amounts of copper.

3. Twenty-six Intermountain lead-zinc plants making a lead concentrate and a zinc concentrate treated 3,607,000 tons of ore, producing 297,136 tons of lead concentrate and 443,783 tons of zinc concentrate. Lead concentrate averaged 49.46 per cent lead, 1.56 per cent copper, 7.40 per cent zinc, and 35.74 oz. of silver per ton. Ratio of concentration (feed: lead concentrate) was 12.15:1. Zinc concentrates averaged 51.20 per cent zinc, 3.94 per cent lead, 0.64 per cent copper, and 9.18 oz. of silver per ton. Ratio of concentration (feed: zinc concentrate) was 8.13:1. The statement was made in the foregoing that the lead concentrate contained 7.4 per cent zinc; it was unfortunately not possible to get the figures from all the producers, and reports were obtained from only eight of the plants; these eight plants, however, treated 39 per cent of the total tonnage, producing 48 per cent of the total lead and 47 per cent of the total zinc. Figures obtained for these representative producers may, perhaps, safely be applied to all. Table XI, which presents the data pertaining to these complex lead-zinc ores, brings out the fact that about 90 per cent

of the recovered lead is in the lead concentrate, and an equivalent amount of zinc is in the zinc concentrate; 62 per cent of the recovered copper is in the lead concentrate, and 38 per cent in the zinc concentrate; the proportionally larger collection of copper in the zinc concentrate may, in part, be attributed to the fact that the copper sulphate added to activate the zinc would undoubtedly find its way as copper sulphide to the surface of the zinc sulphide, and hence be recovered in the zinc concentrate. From Table VIII it is seen that the total amount of copper sulphate used in activating the sickened sphalerite of complex lead-zinc ores was 4,436,662 lb., meaning that 1,145,000 lb. of copper was added to the zinc circuits. If all of this copper were replacing zinc at the surface of the sphalerite particles, about one-fifth of the copper in the zinc concentrate would be accounted for by the copper sulphate added to activate the flotation of the zinc sulphide.

Table IX—Reagent Consumption in the Treatment by Flotation of Miscellaneous Ores.

(Tons treated, 561,866; number of plants, 12)

Reagents	Amount, Pounds	Pounds per Ton	Number of Plants
I. Frothers:			
Pine oils	18,809	0.033	9
Cresols	750	.001	1
Amines	300	.001	1
Alcohols	300	.001	1
	20,159	.036	10
II. Collectors:			
1. Oils			
Coal-tar creosotes	7,993	.014	4
Wood-tar creosotes	11,195	.020	3
Crude oils	52,073	.093	2
Water-gas oils	37,338	.067	2
Reconstructed oils	1,350	.002	1
	109,949	.196	
2. Chemicals			
Ethyl xanthates	34,234	.061	8
III. Acids and Alkalis:			
2. Alkalis			
Sodium carbonate	290,555	.518	2
Lime	62,019	.109	4
	352,574	.627	5
IV. Other Inorganic Reagents:			
2. Activating reagents			
Copper sulphate	17,480	.031	1
3. Depressing reagents			
Cyanides	23,480	.042	4
Sodium sulphite	11,000	.019	1
Zinc sulphate	348	.001	1
	34,828	.062	5
Summary:			
Frothers	20,159	.036	10
Collectors:			
1. Oils	109,949	.196	8
2. Chemicals	34,234	.061	8
Acids and alkalis	352,574	.627	5
Activating reagents	17,480	.031	1
Depressing reagents	34,828	.062	5
Total	569,224	1.013	12

Table X—Reagent Consumption in 1,000 Pounds to the Nearest 1,000 Pounds.

	Copper Ores	Lead Ores	Zinc Ores	Lead-Zinc Ores	Miscellaneous Ores	Copper Iron Ores
Tons treated	40,881,768	2,596,314	1,708,388	3,827,856	561,886	497,238
Number of plants	25	29	42	28	12	3
Reagents, total:						
Frothers	5,127	418	323	572	20	123
Collectors (oils)	1,415	486	148	1,227	110	123
Collectors (chemicals)	4,243	314	222	903	34	51
Acids	0	1	3	0	0	9,745
Alkalis	164,018	1,913	1,088	6,943	353	2,452
Sulphidising	4,004	884	0	203	.....	.....
Activating	0	6	1,380	4,437	17	69
Depressing	1,452	498	1,530	3,239	35	5
Miscellaneous inorganic	0	5	2	366	0	0
Protective organic colloids	0	0	0	10	0	
Reagents, Pounds per Ton						
Frothers	0.125	0.161	0.189	0.149	0.036	0.248
Collectors (oils)	.034	.187	.086	.321	.196	.248
Collectors (chemicals)	.104	.121	.130	.236	.061	.102
Acids	0	0	.001	0	0	19.599
Alkalis	4.012	.737	.639	1.813	.627	4.932
Sulphidising	.098	.341	0	.053	0	0
Activating	0	.002	.808	1.159	.031	.139
Depressing	.035	.193	.895	.846	.062	.010
Miscellaneous inorganic	0	.002	.001	.095	0	0
Protective organic colloids	0	0	0	.003	0	0

Table XI—Metallurgical Results Obtained in 26 Intermountain Lead-Zinc Differential Flotation Plants in 1927.

	Lead Concentrate	Zinc Concentrate
Tons produced	297,136	443,783
Lead content, in 1,000 lb.	293,944	34,936
Zinc content, in 1,000 lb.	44,000	454,402
Copper content, in 1,000 lb.	9,314	5,706
Silver content, in 1,000 oz.	10,620	4,073
Lead content, per cent	49.46	3.94
Zinc content, per cent	7.40	51.20
Copper content, per cent	1.56	0.64
Silver content, oz. per ton	35.74	9.18
Percentage of lead recovered	89	11
Percentage of zinc recovered	9	91
Percentage of copper recovered	62	38
Percentage of silver recovered	72	28

Conclusion

The general trend of reagent consumption has led to the more extensive use of chemical collectors, the more widespread and judicious use of alkaline circuits, and greatly increased consumption of depressing reagents. The large increase in the consumption of copper sulphate can be ascribed to the erection of a number of plants for recovering zinc slimes in the Tri-State district, and to the addition of zinc-floating sections to plants that previously made only a lead concentrate or a collective lead-zinc concentrate. Although no direct comparison has been possible, the metallurgical results obtained in 1927 appear to be a distinct improvement over those of the previous year.

Sales of Lead and Zinc Pigments and Zinc Salts Increase in 1928

SALES of all of the lead pigments with the exception of white lead ground in oil and orange mineral increased in 1928, according to the U. S. Bureau of Mines. This increase was made notwithstanding substantial decreases in the average values of all lead pigments.

Sales of zinc pigments and salts were generally higher in 1928, with a notable increase in the sales of lithopone to a new high record of 200,468 short tons. (Prices for zinc pigments and salts were $1 to $2 a ton lower than in 1927.) Sales of lithopone were distributed as follows: for paint, varnish, and lacquers, 149,122 tons; for floor coverings and textiles, 35,416 tons; for rubber, 6,898 tons; and for other uses, 9,032 tons. Lithopone producers report an annual productive capacity of 227,000 tons. Comparative figures for 1927 are: for paint, varnish, and lacquers, 131,145 tons; for floor coverings and textiles, 31,186 tons; for rubber, 7,653 tons; and for other uses, 7,010 tons. The annual capacity reported for 1927 was 202,000 tons.

THE AUSTRALIAN MINING INDUSTRY enters a new era. Under the direction of Mr. Leslie Urquhart, chairman of Russo-Asiatic, the development of the Mount Isa property, as a large-tonnage, low-cost producer of zinc, lead, and silver, is well under way. Mr. Urquhart passed through New York recently. An interesting interview is scheduled for an early issue.

COMMENT AND CRITICISM

Fine Grinding and Adsorption Troubles

To the Editor of "E.&M.J.":

The metallurgical difficulties encountered in the treatment of colloids and primary slime were discussed in an interesting manner by Messrs. John Gross, S. R. Zimmerley, and John Dixon in *Engineering and Mining Journal* of Dec. 15, 1928, and by F. H. Jackson, in the issue of March 16, 1929. The excerpt from the transactions of the Institution of Mining and Metallurgy (1915) was also timely. Gravity concentration, cyanidation, and flotation have each paid a penalty in lowered extraction and/or increased costs, because of the presence of primary slime or colloidal matter in the ore treated. These writers have provided food for thought.

Flocs of colloid slimes in cyanide solution are probably under intermittent osmotic pressure, the action occurring in cycles, the floc rupturing at the pressure limit and regathering with a charge of new solution of the same concentration as the surrounding liquor. The metal remaining in the floc, by dissolving, will again raise the internal concentration and complete the cycle. If osmosis is not a factor, diffusion remains to be considered.

Deflocculation in cyanide solution seems impractical because the electrolyte is present at uniform strength and sufficient to have formed the original floc, and such strength must be maintained for thickener efficiency and the protection of cyanide. Dispersion by chemicals would be a delicate and uncertain operation owing to the probable presence of particles of different polarities. It would necessitate a separate curcuit because of detrimental effects on cyanide consumption.

I agree with Mr. Dixon's hypothesis that the flocs are impermeable to diffusion, tough enough not to be broken up by the agitators, and yet weak enough to be broken down by pressure filtering. My own experiments have proved this to my satisfaction. The precious metal in the underflow from the final thickener in a counter-current decantation plant could not be reduced by washing, whereas filtering on an Oliver at 22-in. vacuum lowered the tailing value 25 per cent. The remainder was proved to be undissolved.

Pulp and wash solution mixed by small mechanical agitators, as used in some mills between washing thickeners, probably has a slight effect on the molecular structure of the floc, possibly causing a temporary ionization and an almost immediate return to the neutral state.

Intermediate filtering and repulping might prove beneficial by breaking down the floc, using barren solution for repulping, thus reversing the osmotic flow when the floc has regathered. I had planned to test this theory a year ago, but conditions have prevented. The logical location for such an installation would be after agitation and before washing.

Granted that a total cure for this evil is not now known, present knowledge cn be applied to accomplish a partial prevention. Crushing by impact, multiple classifiers, and high dilution in grinding mills would result in less of the obnoxious over-ground material, with a saving on grinding costs. As the reduction of ore to and not beyond a required size is a fundamental of ore dressing, it should be recognized and so treated.

E. G. Howe.

Etzatlan, Jalisco, Mexico.

The Prospector Replies

To the Editor of "E.&M.J.":

In the issue of *Engineering and Mining Journal* of May 11 appeared an article by Mark R. Lamb, of Buenos Aires, under "Comment and Criticism." It seems to me that Mr. Lamb covered too much territory when he spoke of the prospector having increased in numbers, but probably he means around Buenos Aires. I fail to see it here in this part of Alaska. I would like to know just why a prospector should confine his promoting ideas to such persons as business men and dentists, instead of having an engineer look at the property in the interest of some mining company. There would be very few mining companies and not quite so many engineers if it were up to the business men and dentists he speaks of. He states a prospect is always a long chance, but I can't see how we can have a mine without its first being a prospect of some sort. Not long ago I saw an article in *Engineering and Mining Journal* stating that a mine is always a prospect, but a prospect is not always a mine, and that we will always have good prospects and poor ones. If a prospector has anything worth while, the sooner he has an engineer go over his property, the more likely he will be to get a mining company interested. What interests an engineer will always interest a company; and most companies have enough money to take some measure of risk, and so, if the prospect doesn't prove to be a mine the prospector's conscience should not bother him. Being only a prospector, his article interested me.

Herman Kloss.

Wasilla, Alaska.

Simplifying the Geophysical Survey

To the Editor of "E.&M.J.":

The U. S. Coast and Geodetic Survey is considering a short-cut method for gravity determinations which, according to Major William Bowie, chief of the Geodetic Division, probably will greatly enhance the usefulness of gravity pendulum equipment in geophysical prospecting. Under present methods, the observation at any given point in a geophysical survey takes at least 48 hours. A complete run must be made at each station. The short-cut involves the use of a master pendulum swung at a point of known gravity. Its beats are to be transmitted by short wave radio to the field station and made a part of the photographic record of a second pendulum set up over the point where g is to be determined. Since the two instruments are calibrated with each other, gravity at the field station can be measured by comparison without making a complete run. Thus a field observation can be made in about an hour and a half.

Further time saving may be effected by use of a pendulum of the Meinesz type, which probably can be mounted on a truck trailer. If so, the time necessary to construct a concrete or stone support on the ground and to set the pendulum case on it will have been eliminated. It is believed that if the new method is successful, one or two gravity stations can be established in a single day, whereas five per month is considered a fair average under present methods. This increased speed, it is pointed out, should reduce considerably the cost of geophysical surveys and promote more thorough studies in areas under investigation. The only extra expense, which should be compensated several times over by the increased output, is that of added equipment and the salary of an attendant for the master pendulum. There is no reason to suppose that the precision should be less than in present measurements, which are accurate within one part in a million.

The Meinesz instrument employs two pendulums swinging in the same plane

in opposite phase. This eliminates errors that result from "flexure" or movement of the case, such as is caused by swinging a single pendulum. Dr. F. A. Vening-Meinesz, the inventor, used his apparatus last fall aboard the submarine "S-21" for gravity measurements at points off the Atlantic and Gulf coasts.

Briefly, the pendulum principle is applied to geophysical prospecting to show the density of buried rock formations. Since the attraction of one body for another varies inversely as the square of the distance, the pull of gravity will be less than normal when the heavy igneous rock is covered by thick deposits of lighter sedimentary material and greater than normal when the heavy rock is close to the surface. The earth's attraction is measured by the period of a pendulum oscillating in a partial vacuum on delicately balanced pivots. Obviously, values of g over anticlines, or buried ridges, are too great, and over synclines, or buried troughs, are too small.

Thus the principle is being used with some success in locating salt or oil domes, at which points the heavy rocks are closer to the surface and cause "positive gravitational phenomena."

PAUL WOOTON.

Washington, D. C.

A Facetious Zephyr From Santa Monica

To the Editor of "E.&M.J.":

In your issue of May 18 appear two letters suggesting a word to designate briefly and appropriately that material so often found in mines which is too lean to be called "ore" and yet which is not properly waste. One writer suggests the term "junore" and another proposes "culdore." Both are good, but I beg permission to join the contest and, if not to suggest a better word, at any rate to add to the gaiety of the occasion. I respectfully—and even hopefully—submit the word "bevore," which means, of course, "near" ore, just as "bevo" means near beer.

It will require very little profundity to see the logic in the coinage of this descriptive and euphonious word. To be sure, some old crank he-miner, who hates Volsteadism, will raise an objection to anything that sounds like "bevo," because of the futility of that effort to induce morons to kid themselves into believing that they are drinking the real stuff. However, any such objection will be largely prejudiced and unworthy of sober, scientific men who are earnestly seeking a solution of this important problem. I am quite sure that President Hoover will have no such prejudices and that he would endorse my noble experiment at word-making as he has endorsed—in principle at least—the experiment of trying near beer. H. H. HUGHES.

Santa Monica, Calif.

Safe and Unsafe Practices

To the Editor of "E.&M.J.":

I read with interest the criticism of Mr. M. J. McCarthy in regard to the exceptions taken by Mr. Arthur La Motte to Mr. McCarthy's paper on safety published in the issue of April 27. In regard to the accident in 1886 at Aspen, Colo., where a man lost both hands by slitting a cartridge of Hercules No. 2 (40 per cent) powder with a pocket knife, which caused its explosion: low freezing nitroglycerin explosives were unknown at that time. It was also known that it was very dangerous to cut, crush, or in any way break up a stick of frozen dynamite. This Hercules No. 2 powder was the old-time straight nitroglycerin dynamite, which is very sensitive. I think that this explosion probably was caused by the fact that the dynamite was frozen. This is borne out by the further fact that the miner lost both hands instead of being killed, because frozen dynamite always detonated incompletely. In other words, it did not explode with its maximum force.

In regard to the safe or unsafe practice of using a metal for priming a stick of dynamite: in recent years another angle to this has come up. Wood absorbs nitroglycerin, and this is true of wooden punches used continuously in the making up of primers, and therefore there comes a time when the punch itself becomes dangerous because of the absorbed nitroglycerin; it must be destroyed as soon as it becomes permanently "greasy." For this reason several large mining companies have adopted the metal punch and prefer it to the wooden one.

C. S. HURTER,
Technical Representative,
E. I. du Pont de Nemours & Company.
Seattle, Wash.

BY THE WAY

No Need for the S.P.C.A. at the Republic Mine

MONTANA COAL MINES are valuable not only for the carboniferous fuel contained therein, but also for raising horses. Comes the news from Kelin, Mont., that Diana Miner, a colt, born and raised in the Republic mine, at the age of 23 months will first see the sunlight. Diana now tips the scale at 1,250 lb. and is too large to ramble through the mine passages. On the theory that things equal to the same thing are equal to each other, Richard the Third, were he living today, would be willing to exchange his kingdom for a Montana coal mine.

The Proper Custom

THE New York *Journal of Commerce* brings up an interesting point in a recent issue, as follows:

"An interesting question—which, however, is not keeping any one awake nights—is how to spell 'custom smelter,' or 'customs smelter.' The custom (or customs) smelters have been much in the public eye of late, since they are the only ones who have been in the market to sell copper. Half the press uses 'custom' in the singular—half in the plural. *Engineering and Mining Journal*, often called the Bible of the mining industry, uses the world in the singular. *American Metal Market*, another trade paper, has used it in the plural. The more popular newspapers are also divided on the subject. In other words, it resolves itself into the question of what is the prevailing custom as to the spelling of custom (or customs) smelter?"

To us, there seems no choice. To be sure, one occasionally hears the term "customs smelter," but this, we hold, is merely slovenly terminology, suggested perhaps by the fact that that department of the government concerned with the importation of foreign goods is known as the "customs." One may thus speak of a "customs tariff." But in the case of a smelter or mill, the proper adjective form is "custom" which is derived from the sixth meaning of the noun "custom" given by Webster—namely, "Habitual buying of goods."

Fluorine From Fluorspar by Electrolysis

FLUORINE, the gaseous chemical element, heretofore isolated in only small quantities, has been produced electrolytically in 1,000-cu.ft. quantities, by Professors Wilder D. Bancroft and Newton C. Jones, of Cornell University.

As a result, a new method of analyzing organic compounds will be developed. Determining just how some chemicals are put together has been difficult because dissociation with electric current, a fruitful method for some compounds, cannot be used on solutions that do not react to electricity. Fluorine, however, reacts with almost any organic substance, whether electrolytically conducting or not, and it displaces that portion of the substance that would have appeared at the anode pole if it had been electrolyzed.

These findings and possibilities were reported to the American Electrochemical Society meeting at Toronto. Professors Bancroft and Jones also discovered that fluorine when it reacts with benzine does so explosively, although this was unexpected in the light of properties of the two gases hitherto known.

Large quantities of fluorine occur in different parts of the earth's crust, but it is practically all very tightly locked in combination with other elements. One of the common minerals containing it is fluorspar. In school chemical laboratories students know one of fluorine's compounds, hydrofluoric acid, because of its property of etching glass.—*Science.*

Digest of Current Literature

Flotation. *Metall und Erz,* 2d April No., pp. 193-203. A series of papers on flotation: (1) Karl Kellermann, "Colloid Chemistry of Flotation." The older theories of flotation are dismissed with a brief review. Of the newer theories, adsorption is emphasized; but it is shown that no one theory accounts for all the observed facts. Topics deserving particular attention are the capillary behavior of ore pulp and froth, the effect of minor impurities on the surface properties of the ore, and the influence of chemical flotation reagents. In the absence of any experimental measure of floatability of an ore or the effectiveness of a reagent, a method for such estimation is being worked out, on the principle of measurement of the maximum size of bubble which can be made to adhere to a particle of the ore. (2) W. Luyken and E. Bierbrauer, "Relations Between Adsorption, Wetting Power, and Flotation." Development of a method for flotation concentration of apatite from waste slimes in Sweden, using sodium palmitate exclusively, led to a simple flotation model which was used as a basis of new theoretical considerations. It is shown that there is an essential connection, governed by precise laws, between adsorption capacity, wetting power, and floatability. The chemical nature of the surface reactions involved in adsorption of sodium palmitate is also elucidated. (3) W. Luyken and E. Bierbrauer, "Flotation Concentration of Apatite." The apatite flotation process, referred to above, was developed to treat a Swedish ore of mixed magnetite and apatite, in which the relatively non-magnetic apatite was lost in magnetic concentration of the magnetite. The phosphorus content of the apatite was needed to give the ore the needed composition for forming Thomas slag. Use of sodium palmitate made possible a low cost (2 marks) per ton for the flotation process.

Roasting Zinc Blende. Franz Klein. *Metall und Erz,* first number of May, pp. 217-25. A physico-chemical study has been made of the course of the roasting process used in producing zinc from its sulphide ores. A small experimental set-up was used, in which the conditions of temperature and air supply could be accurately controlled and known. A chemically precipitated sulphide and a natural ore of nearly the same composition were used. Statements in the literature differ widely as to the temperature at which roasting (evolution of SO_2) begins. With precipitated sulphide this temperature was found to be 345 deg. C.; with zinc blende, 350 deg. C. The rate of reaction increases, of course, with rising temperature; but not in linear relation. In the temperature range 470-550 deg. C. the relation is disturbed by a new influence, the ignition of the sulphide. In this range there is also decomposition of zinc sulphate, which is formed only through intermediate formation of zinc oxide. Particle size influences the course, but not the beginning of the roasting reaction; coarser particles tend to a slower reaction rate, but the effect grows smaller as particle size increases, until size ceases to have any influence. The decomposition of zinc sulphate, beginning in the ignition temperature range, does not increase markedly until above 700 deg. C. In at least part of this decomposition a basic zinc sulphate is formed as an intermediate product. The decomposition is catalyzed by zinc sulphide, but not by the oxide. Neither the sulphide nor the oxide is a catalyst of the formation of the sulphate; hence it is difficult to effect satisfactory sulphating of the ore by ordinary roasting. Thermal studies of the roasting agree with the analytical findings.

Dewatering Sand. J. Nahnsen. *Braunkohle,* April 27, pp. 356-8. In mining lignite and other minerals it is often necessary to dewater the wet sand layers with which such deposits are frequently associated. The cost of this operation is an important factor in the mining costs; but there has not hitherto been any standard by which the ease of dewatering could be measured or even roughly estimated in advance. A method and instrument for such quantitative estimation have now been developed. The principle of the method is that the water in sand is held by two forces, adhesion and capillarity, the adhesion water being easy and the capillary water hard to remove. Hence the degree of capillarity of a sand gives a measure of the difficulty to be expected in dewatering it. Based on this idea, a simple capillarometer has been devised, with which borings from the sand layer can be tested. The instrument is described and illustrated, and a sample calculation is given. A limitation of the method is that the sample must be removed from its environment for testing, so that any factors depending on this must be neglected. That is, the method indicates the petrographic but not the tectonic dewatering behavior.

Coley Zinc Process. *Chemical Trade Journal,* April 26, p. 392. The Coley process for ore reduction does not, as commonly believed, depend on paraffin as reducing agent. Liquid hydrocarbons were used in the experimental development of the process, but the method has now been reduced to commercial practice on the basis of using powdered coal or a like carbonaceous solid as reducing agent. The new process arose from the idea that the use of carbon monoxide as a metallurgical reducing agent is unsound in principle and that carbon, formed in nascent state from hydrocarbons or a like source, would be much more effective. Experiment and large-scale operation have confirmed this prediction, and zinc is being successfully produced from its oxide by the Coley process.

Metals From Salts. W. N. Ipatiew and O. E. Swjaginzew. *Berichte der deutschen chemischen Gessellschaft,* March 6, pp. 708-10. Copper, zinc, bismuth, cadmium, nickel, and other metals can be displaced from their salts in aqueous solution by hydrogen under pressure at 120-350 deg. C. Some metals, including iron and manganese, yield hydroxides or oxides; others, the free metal. In the case of ruthenium, either hydroxide, oxide or the metal can be precipitated by the hydrogen reaction, according to the conditions of the experiment.

Chrome Ore in New Caledonia. A. Magnin. *Echo des Mines et de la Metallurgie,* 1929, pp. 338-40. The chrome mining industry of New Caledonia is threatened by heavy export taxes. An impression prevails that the world chrome market is controlled largely by New Caledonian output, and that Tiebaghi is the richest chrome mine in the world. Under present conditions, both impressions are wrong. Quarry mining at Tiebaghi is now over, and the methods of winning ore now necessary constitute a heavy burden on production costs. For instance, it has been necessary to bore a tunnel more than 2,000 ft. long through solid rock to gain access to a 250-ft. deposit. The ore must be mined from below through timbered drifts, and the timbers are not recovered. In spite of these heavy expenses, the Tiebaghi mine should be able to produce ore in quantity for years to come if not prevented by excessive taxes. The poorer but more easily exploited deposits in Turkey, Jugoslavia, and Greece may become dominant in the world market if the price situation allows them to compete. Already, Rhodesia has far outstripped New Caledonia as a chrome producer, and for some years India has also been in the lead. The place held by New Caledonia is maintained largely by virtue of the better quality of its ore, which gives it a preference among consumers. The industry would find it helpful, among other things, to exploit more actively the use of chrome ore for refractory linings.

Magnesite. G. M. Dyson. *Chemical Age,* April 20. pp. 376-7. The commercial value of magnesite deposits depends both on the purity and the physical state in which the mineral occurs. Commercially important deposits of Canada and Central Europe are in a coarsely crystalline form; in India, Greece, and California a compact form (somewhat like chalk) prevails. The dolomitic magnesites have less value than the high-magnesia varieties, but may become an important source of magnesium metal because dolomites are abundant and cheap and the uses of magnesium metal in industry show promise of increased demand in the future. Silica is the most harmful of the common impurities in magnesite; at the necessarily high temperature of calcination it causes slagging and lessens the quality and yield of the product. Methods and equipment for calcining are described, and uses of magnesite, magnesia plastics, and dead-burnt magnesite are stated.

Metallurgical Dusts. B. V. Lambert. *Metal Industry* (London), May 10, p. 467. Methods and equipment for dry recovery of dusts and fumes from metallurgical and like processes are reviewed. Cleaning of effluent gases is often an economic necessity, either because the dust has value of its own or because it is obnoxious or constitutes a fire, explosion, or health hazard. Cyclonic or centrifugal separators, settling chambers, and friction plates are useful for the coarser dusts, but are not effective for the particles small enough to form clouds or smokes. For these finer particles, a bag filter or an electrostatic precipitator is required. Cotton is most suitable for bag filters if not exposed to free acid nor to temperatures above 90 deg. C.; wool is stable to weak acids and up to 120 deg. C., but sets up more back pressure than cotton. A well-designed bag filter system can be made at least 99 per cent efficient. Electrostatic precipitators approach the best bag filter efficiency, and are effective for very hot or acid gases where such filters cannot be used.

INDUSTRIAL PROGRESS

Advance Made in Brass Melting

An Apparently Revolutionary Process Devised

DEVELOPMENT through co-operative research of a process that to all appearances should revolutionize brass melting was announced recently by Alexander Forward, managing director of the American Gas Association. A radically new type of brass-melting furnace has been developed as a result of the association's half-million dollar program of industrial gas research. For the first time in the history of the brass industry, the fragile and crumbling crucible and refractory lined furnace have apparently been supplanted with a permanent retort of special alloy metal, apparently of indefinite life. Its advantages are summarized as follows: (1) Astoundingly low fuel consumption of only 2½ cu.ft. of gas a pound of brass melted, superseding other fuels. (2) Practical elimination of metal losses during brass melting. (3) Apparent elimination of the costs of crucible and refractory maintenance. (4) Automatic temperature control. (5) Greatly improved working conditions in foundries, resulting in labor saving, greater efficiency of workers, and avoidance of excessive heat, noise, and the production of fumes.

Foundrymen have never before known how to avoid the great loss of metal in brass melting, nor the heavy costs of crucible maintenance, and have been at a loss as to the most economical fuel for this use. In many types of furnaces, metal losses during operation equal or exceed the cost of fuel, whether gas, oil, or coke.

Through co-operative research between the American Gas Association and the American Gas Furnace Company at Elizabeth, N. J., a metal alloy has been developed that will repeatedly withstand working temperatures in excess of 2,000 deg. F., in contact with molten metal. Although crucibles have a life of only fifteen to twenty heats, the first retort made from this new alloy has already served for more than 250 heats and is none the worse for wear.

The new brass melter consists of a revolving metallic retort, externally fired and inclosed in a shell for heat concentration, atmospheric control, and fuel conservation. The heavily insulated sheet steel drum or shell is mounted on two bearings held by a steel frame, so that it may be tilted at any desired angle. Then gas burners, five on each side, are mounted on this drum in such manner that they fire into its interior. Within the drum is a special alloy metal retort so mounted that it revolves with a motor and variable chain and gear drive.

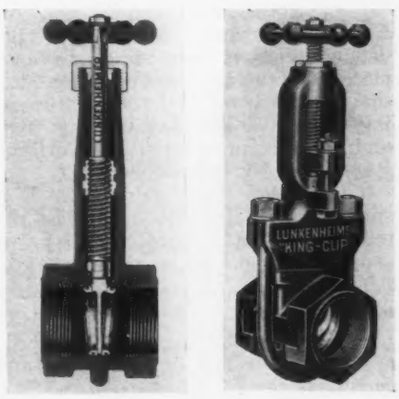
Announcement of the new process was not made public until after repeated and exhaustive tests had been made under the most exacting conditions. The first installation in commercial practice is at the plant of the Trenton Brass & Machine Company, of Trenton, N. J., a concern manufacturing plumbers' supplies and selling direct to jobbing plumbers and makers of sanitary ware. This particular foundry has experimented extensively for many years with every kind of fuel and energy and every type of brass-melting furnace, in order to reduce costs to a minimum and obtain the best possible control over its foundry practice and the final quality of its castings. Prior to the introduction of the gas melter, coke-fired pit furnaces, gas-fired furnaces, and electric furnaces had been rigidly tried and discarded and an oil-fired crucible furnace had been standardized upon. Inasmuch as these oil-fired crucibles represented the best foundry practice the Trenton management had been able to effect, they afforded the most valuable yardstick with which to measure the economies of the new gas melter. The same foundry practice is used with both, so there is no chance for variables to enter. As a result the gas-fired installation has fully demonstrated its supremacy.

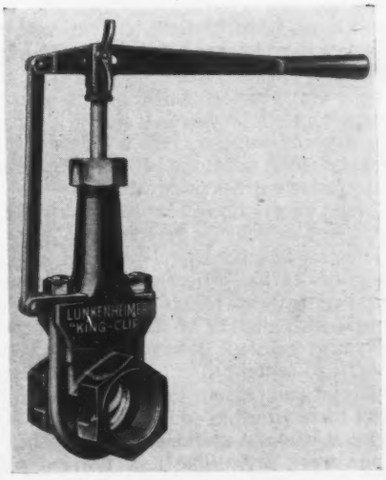
Heretofore under the best practice the volatilization losses during melting ran between 5 and 6 per cent, and each crucible when pulled from the furnace has to be skimmed of the oxidized metal before it can be taken to the pouring floor. These losses are now practically eliminated, as the only loss under the new method is during the pouring operation and is so minimized that there is scarcely any variation in the chemical analysis of the castings. Furthermore, a more workable casting is produced, one that is more easily machined than are castings made from crucible metal.

The Equipment Review

A Gate Valve of New Design

A new valve, known as the "King-clip" gate valve, has been developed by the Lunkenheimer Company, Cincinnati. Its design is such as to make possible equally satisfactory results on steam, oil, gas, air, water, and gasoline lines. As a whole, the valve is strongly built to withstand rough usage. It is made in three designs—namely, the rising-stem inside-screw type, the outside-screw-and-yoke type, and the quick-operation type. All three are procurable in an iron body, bronze mounted, and in all-iron patterns, with either screw or flange ends.





Three types of a recently introduced design of gate valve

The body is made of iron especially alloyed for valve service. Substantial hexagons resist wrenching strains and piping stresses. The thread length accommodates both the American Standard and the A.P.I. line pipe. On screwing up a valve the pipe ends will

not jam against the diaphragm or the seats. Valves of the flange-end type have 125-lb. American Standard iron flanges and are plain faced. The face-to-face dimensions of valves of this type are according to standard trade practice.

The steel clip provided in the design affords a simple effective method of making connection between body and bonnet. It facilitates dismantling for cleaning or inspection and lends strength and rigidity to the body.

The stuffing box holds an ample supply of packing. A screwed stuffing box nut is used in valves up to 3 in. inclusive; sizes 1 in. to 3 in. inclusive have gland follower. A bolted iron gland is employed in the 3½-in. and 4-in. valves.

Pressure ratings of these valves are as follows: Screw ends ¼ to 2 in. inclusive, 150-lb. working steam pressure, 225-lb. gas or liquid pressure; screw ends 2½ to 4 in. inclusive and flange ends 1½ and 4 in. inclusive, 125-lb. working steam pressure, 175-lb. gas or liquid pressure.

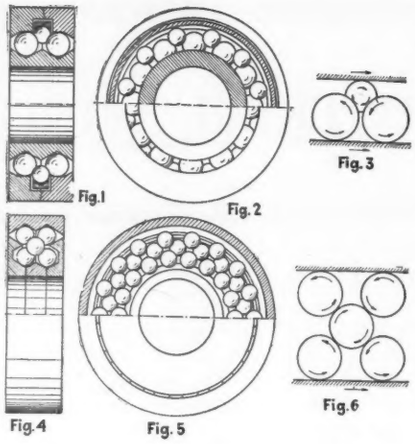
A New Type of Ball Bearing

A ball bearing having two and more rows of balls has been developed in Berlin and patented in most countries. The main feature of the new bearing is that a cage is dispensed with in favor of a third row of small balls, above and between the two rows of bearing balls and serving solely to keep the bearing balls from touching one another. The small bearing balls, which may be called distancing balls, are held by a grooved ring, which is able to revolve freely inside the body of the bearing. The arrangement is depicted in Figs. 1, 2, and 3. In these the inner race, having two grooves, contains the two rows of bearing balls. The row of distancing balls and the ring containing them are seen beyond and between the rows of bearing balls. This outside race consists of two halves.

Apart from the great advantage that a cage is not used, the ball bearing offers the following other advantages:

Gliding friction is replaced by rolling friction, evident by reference to Fig. 3. This, as has been demonstrated, makes a considerable difference. In a rough experiment, in which comparison was made with another of standard make and exactly similar dimensions, the new bearing (equipped with the same flywheels and given the same impulse) ran three times as long as the other before it came to a standstill. Both bearings were dry. The new bearing was almost noiseless, whereas the other emitted grating sounds.

A further advantage of the new bearing is its simplicity, cheapness, and the ease with which it can be assembled and taken to pieces. Its manufacture requires no new machinery, and any present maker of ball bearings could immediately produce it. A valuable feature should also be the fact that the bearing is capable of taking up considerable thrust. The divided outside races have conical faces, which give an



The new bearing, here illustrated, is unique in having more than one row of balls

exceedingly close fit and have so far proved wholly efficient. A very simple tool is required to press the two parts together and to take them apart. As already mentioned, the assembling is simple, and it requires in fact only a part of the time usually demanded by normal bearings.

Though this bearing has already been developed to a stage permitting production—official tests are now being conducted in Germany—the inventor has suggested a new design, which, however, has not yet been tested, the features of which will be understood by reference to Figs. 4, 5, and 6, from which it will be seen that the holding ring of the distancing balls has been replaced by two further rows of bearing balls. In this design, it is the inner and not the outer race which is divided. The inner race consists of three divisions, which make the assembly of this bearing also an easy procedure.

Two New Hand-Rotated Stopers Are Available

Chicago Pneumatic Tool Company announces the CP-146W stoper (wet), which combines high drilling speed, light weight, short over-all length, ease of operation, low upkeep, and exceptionally effective and convenient air feed control for difficult drilling conditions. Being fully cushioned and valve actuated, it does satisfactory work under poor conditions, such as low air pressure, wet air, and the added handicap of worn parts. Tests show the CP-146W to have particularly high drilling speed in hard rock. In some places it has equaled, and even exceeded, the drilling speed of heavy, self-rotating stopers. The sensitive air feed control results in uniformly high drilling speed in broken formations.

The CP-146 stoper (dry), which is similar to the CP-146W in essential details, is available where that type of drill is required. Its main features are:

1. Symmetrical balanced design; easy to operate.

2. Exceptionally high drilling speed over a wide range of formations and conditions.

3. Light weight—5 to 8 lb. under that of corresponding types of valveless stopers.

4. Four-bolt construction, which gives ready accessibility to all working parts.

5. Spring-retained front head.

6. Fully cushioned, one-diameter piston, which insures long life.

7. Rugged, tubular valve, housed in renewable bushings in the cylinder wall, and piston-controlled exhaust. No tendency to "freeze" under the worst conditions.

8. Effective, air-operated feed control, conveniently located in the rotation handle. No springs, buttons, or plungers to get out of order.

9. Full 24-in. feed travel, which facilitates steel changes.

10. Air and water swivel connections conveniently located.

11. Automatic lubrication.

Great Care Used in Making U-Tube Manometers

ONE of the simplest forms of instrument for measuring pressure, vacuum and flow of gases and liquids and draft pressures is the ordinary U-tube manometer. Essentially, it consists of a suitable length of glass tube bent in the form of a U, the ends being connected to the two points, between which is the difference of pressure or other factor required to be measured. The total difference between the levels of the liquid in the two arms of the U-tube shows the difference in pressure conditions between the two points to be tested, and a suitable scale set beneath the tube permits the taking of direct readings.

D. C. Beckett, secretary of the Meriam Company, of Cleveland, gives some interesting details of the methods employed to insure accuracy and reliability in the making of manometers; for, like all precision instruments, they demand close attention to details in spite of their apparent simplicity. The Meriam Company has for a number of years specialized in this type of instruments and has recently moved into a new well-equipped plant.

One of the chief advantages of the U-tube manometer is that its operation is absolutely reliable because it depends directly upon unchanging physical laws, and not upon diaphragms, springs or other mechanical equipment which must inevitable deteriorate as time progresses. Since, moreover, its action is differential, it is practically independent of inaccuracies in the bore of the glass tubing. For this reason, the manometer may be used to check the accuracy of other instruments. Great care should therefore be maintained throughout the process of manufacture. Strength and reliability are equally important, for it is seldom possible to know where a manometer is to be used. It may, of course, be fixed permanently to a wall —but it is quite as likely to spend its time bumping along in one of the auto-

mobiles which travel from place to place over road-less land, testing pipe-line pressures in the oil fields.

Accuracy of the instrument depends upon the U-bend being free from constriction. It must also be perfectly pressure-tight, for even the slightest leak would not only create enormous errors in the readings, but would also (if under high pressure) be decidedly dangerous.

The tubes themselves are made from a special kind of lead glass adapted for bending at comparatively low temperatures. Bending of the tubes is a highly skilled job and demands special equipment. It is no easy matter, for instance, to bend 100 in. of tubing required for a 50-in. U-tube in such a manner that the bend is free from constriction and the two ends are exactly the right distance apart to fit into the two metal orifices provided for them in the protecting case. This they must do; otherwise the tube will break when fastened down in place. Even the gas used is specially adapted for the work, and its heating power in B.t.u.'s and the "spread" of the flame are carefully regulated within narrow limits.

After bending, the tube is laid in the case resting upon a series of cork-mounted holder clips, and its ends are pushed into the orifices provided in the case, and made pressure-tight. The clips are then closed over the tube, and the instrument is ready for testing.

The method of making the tube leak-proof varies according to the pressure involved. For low pressures, up to 30 lb. per square inch, the ends of the tubes rest upon tapered nipples and packing, and both nipples and tube ends are imbedded in a packed mass of litharge cement. For high pressures, from 300 to 1,000 lb., this is not sufficient, on account of the tendency for the internal pressure to force the ends of the tubes off their seatings. To counteract this, therefore, the U end of the tube is also imbedded in litharge cement, secured from movement by screws projecting into it through the metal case. In addition to this, the ends of the tubes, which are of extra thickness in the walls, are provided with steel headers having high-pressure packing glands. This makes a thoroughly leak-proof joint.

Each manometer is given both a hydraulic and an air-pressure test far in excess of that at which it will operate. In some cases a hydraulic test of over 1½ tons is first applied, because, since water is practically incompressible, the slightest leak will reduce the test pressure dial reading to almost zero. Moreover, should the tube break, owing to misalignment or other cases, no dangerous explosion can take place. The scale is finally fixed in position and the instrument calibrated under working conditions.

Preferably, the manometer scale should be so made as to give directly the value of the quantity to be measured, thus avoiding the necessity of multiplying by a "constant," to get the information desired.

Welding Generator for Belted or Coupled Service

WESTINGHOUSE Electric & Manufacturing Company has recently added to its line of arc-welding equipment a new-design 22-amp. generator not provided with a driving unit, for use in isolated places where electric power is not available and where driving power—such as a gasoline engine, steam engine, line shafting or tractor—is already at hand.

The complete unit consists of a special constant-current Type SK welding generator, with coupled exciter overhung from the generator bracket, control panel, and reactor. The reactor is mounted separately. Over-all dimensions of the generator are small enough to permit mounting the generators in the spaces allotted.

The generator is differentially compound wound and designed for a single operator. Constant-current, variable-voltage characteristics of the generator, together with the separately excited feature, insure a fast, steady, and penetrating arc. Variations in arc length or intensity are automatically compensated by instantaneous changes in the generator voltage.

In this generator the control is mounted on top of the generator frame, and protected by a sheet metal cabinet. The control consists of a voltmeter, ammeter, and a single-dial field rheostat for adjusting welding current over the entire current range.

The generator is rated in accordance with N.E.M.A. standards, 1 hour 50 deg. C. rise on a resistance load at 25 volts. It has a welding range from 60 to 250 amp., and requires a driving unit whose maximum rating is: motor—10 hp.; line shaft—15; gas engines, 20 hp.

BULLETINS

FILTER PRESSES—T. Shriver & Company, 864 Hamilton St., Harrison, N. J. General Catalog No. 29. Thirty-six pages.

FLOODLIGHTS — General Electric Company, Schenectady, N. Y. Bulletin GEA-161D, Novalux floodlighting projectors. Twenty pages.

DRILL SHARPENER—Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill., issues a new bulletin, No. 72-N, on light-model drill-steel sharpener, Class "C," sixteen pages.

HAULAGE, INSULATION MATERIAL—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-991, insulating material for railway and industrial-haulage apparatus. Eight pages.

SWITCHES—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-67A, CR2931 float switches for use with automatic pumping equipment for water-level control. Four pages.

FLOTATION MACHINE — Pan-American Engineering Corporation, Bunting Iron Works, Mills Building, San Francisco, Calif. Catalog "A," Kraut flotation machine; Kraut reagent feeder; Simplex oil burner equipment; laboratory equipment. Twenty-six pages.

INDUSTRIAL NOTES

Jeffrey Manufacturing Company, of Columbus, Ohio, announces the appointment of John L. Connors as assistant general manager of the company.

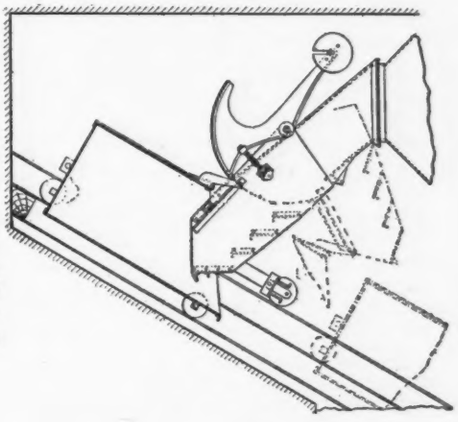
Brown Instrument Company has moved its Boston offices from 161 Devonshire St. to 1107 Public Service Building, 89 Broad St.

The general offices of Foote Bros. Gear & Machine Company have been moved from 215 North Curtis St., Chicago, Ill., to 111 North Canal St. The factory organization will remain at 215 North Curtis St., however.

PATENTS

AUTOMATIC SKIP LOADER. No. 1,710,794. April 30, 1929. C. M. Young, Jr., assignor to Link-Belt Company, Chicago, Ill.

Pivoted at one side of the path of the skip, this chute, after discharging into the skip, is rotated out of line with the travel of the skip. Means are also provided for the skip to wedge the chute out of its path should the chute drop into it.



PRODUCTION OF MERCURY. No. 17,276, reissue. April 23, 1929. W. Glaeser, assignor to Glaeser Research Corporation, New York, N. Y.

A method of extracting mercury from finely divided cinnabar ore. Reaction between the ore and hypochlorite of an alkaline or an alkaline earth liberates mercury, which amalgamates with a metal introduced.

RECOVERY OF ZINC OXIDE. No. 1,712,553. May 14, 1929. C. A. H. de Saulles, assignor to American Smelting & Refining Company, New York, N. Y.

A method of producing zinc oxide of commercial purity from ore. In the process the ore is continuously reduced on a slag bath in a furnace having a slightly oxidizing atmosphere free from impurities. Volatilized zinc products are removed to a separate chamber having a lower temperature than the furnace and containing an oxidizing agent in excess. Zinc oxide is then recovered.

Rock Drills

No. 17,300. May 21, 1929, Reissue. A. H. Skaer, assignor to The Denver Rock Drill Manufacturing Company, Denver, Colo.

A drill steel retainer.

Personal Notes

Burr Wheeler, general manager of Chile Copper, is in New York.

T. A. Rickard passed through New York this week on his way from London to California.

W. H. Harrison has moved his offices from the National Press Building to the Denrike Building, in Washington, D. C.

R. H. Jeffrey, director of Mazapil Copper, has returned to London from New York, after a professional trip to Cuba and Mexico.

Sydney H. Ball, of Rogers, Mayer and Ball, sailed on June 11 from New York for the West Indies on a professional trip.

C. T. Van Winkle, consulting geologist, of Salt Lake City, recently left for Mexico City to make a mine examination.

Arthur A. Zentner, consulting metallurgist, of San Francisco, has just returned from a trip to the Middle West, Northwest and British Columbia.

Prof. **H. Salfeld,** of Göppingen, Germany, recently addressed the Colorado Engineering Council on "Recent Results of Seismic and Electrical Prospecting."

C. E. Biggs is general manager of the Humboldt Mining & Milling Company, which has recently started operations on its property in the Coeur d'Alene district.

J. M. le Grange, of the Witwatersrand University, recently delivered a talk on emeralds and beryls before a meeting of the Geological Society of South Africa.

Frederick Burbidge, general manager of Federal Mining & Smelting, recently returned to Mullan, Idaho, after a trip abroad. He was away about four months.

James M. Hill, geologist, of Berkeley, Calif., has accepted an appointment as consulting geologist with the North American Mining & Smelting Corporation.

John Daniell, chief assayer for Crown Mines, has resigned his position after 30 years of service with the Rand Mines, Ltd., group and is returning to London from Johannesburg.

Colonel **William Boyce Thompson** sailed recently for a trip to the Mediterranean on the "Paris." Colonel Thompson is now in better health than he has been for several years.

Ira B. Joralemon has returned to San Francisco from a reconnaissance trip through the mining districts of Spain. His associate, **H. C. Carlisle,** has also returned to San Francisco.

Glenn Anderson, mining engineer, of Butte, is in charge of operations at the Porphyry Dyke mine, near Rimini, Mont., where Gold Cap Mining is preparing to resume operations.

H. L. Griswold, formerly manager at the Union Copper mine, near Gold Hill, N. C., is in charge of operations at the Hedrick mine, near Ashboro, N. C., which has recently started production.

W. A. Leddell, consulting engineer, of El Paso, Tex., is in New York on business. Mr. Leddell has just completed the design of a cyanide plant for International Ores & Smelting and is busy on the design of two other plants for the Southwest.

W. F. ROBERTSON

H. E. Clement, formerly manager of Porcupine Paymaster, and president of Anglo-London Mining Corporation, has been appointed general manager of the Abana mine, in the Rouyn district of Quebec. He succeeds **W. E. Segsworth,** who resigned recently.

J. R. Hobbins, vice-president of Anaconda Copper Mining, has given the Montana State School of Mines six acres of land west of the main buildings in Butte on behalf of his company. The gift has been accepted by Dr. **Francis A. Thomson,** president of the school.

F. C. Lincoln, professor of mining at the South Dakota State School of Mines, has recently completed a report on the Gold Lode mine, near Hill City, S. D., and has left for Castle Rock, Wash., on mine examination work. He expects to be away from his office for about three weeks.

Benjamin R. Kobey has resigned as president of Hope Mining, Milling & Leasing, operating in the Aspen district of Colorado, to accept the position of general manager of Taylor Park Milling & Power at Taylor Park, Colo. **George Parmer** will succeed Mr. Kobey as president of Hope.

Dr. **George Otis Smith,** director of the Geological Survey and former president of the A.I.M.E.; **Scott Turner** director of the U. S. Bureau of Mines; **John Hays Hammond,** of Washington; **J. V. W. Reynders,** consulting engineer, of New York City; and **Mark Requa,** of San Francisco, are among the seventeen delegates to the World Engineering Congress, which will meet at Tokio this fall, who have been appointed by President Hoover to represent the United States.

E. Bachman, who is in charge of General Electric's mining department, and Mrs. Bachman recently left Salt Lake City for Canada, where Mr. Bachman will superintend electrical construction work at the Flin Flon mine and power plant of Hudson Bay Mining & Smelting. **W. H. Clark,** engineer for General Electric, has been transferred from Denver to Salt Lake to take Mr. Bachman's place while he is in Canada.

G. C. Riddell has moved his New York office from the Woolworth Building to 1 East 42d St. He is now in Mexico, examining quicksilver properties. Associated with him in his new office are **Travers Ewell** and **Thomas K. Meloy,** consulting engineers, specializing in economic surveys and financial studies; and Caribbean Associates, Ltd., represented by **Charles C. Anthony,** a California engineer, who last year made an economic survey of Panama. Mr. Ewell is now in Ecuador.

William Lawrence Baillieu, chairman of the board of directors of Electrolytic Zinc, North Broken Hill, Amalgamated Zinc, and several other Australian companies, and **W. S. Robinson,** director of the Zinc Corporation, Burma Corporation, and Electrolytic Zinc, have been conjointly awarded the gold medal of the Institution of Mining and Metallurgy for their services in the development of the mineral resources of the British Empire, with particular reference to the lead and zinc industry of Australia.

James H. McGraw was given the degree of Doctor of Commercial Science at the commencement exercises of New York University on June 12. In conferring the degree, W. H. Nichols, acting chancellor of the University, said, "Educator transformed into publisher, you have never ceased to be an educator. Your notable career accentuates that tendency in commercial life through which, however private its form, its operations have a public character and become an important element in public education." Mr. McGraw sailed for Europe on June 17.

OBITUARY

George W. Weber, former master mechanic at the Mary McKinney mine, at Cripple Creek, Colo., died at his home in Denver on June 6. He was 69 years old.

William Fleet Robertson, who resigned from the position of Provincial Mineralogist for British Columbia four years ago, after serving in that capacity for 27 years, died at the hospital at Everett, Wash., on June 11, in his 70th year. A few days previously Mr. Robertson had started for England by way of the Panama Canal. He was overtaken by a stroke on board the boat, and was removed to the hospital. Prior to becoming Provincial Mineralogist for British Columbia, Mr. Robertson was metallurgist for the interests since acquired by the International Nickel Company. He had contributed many papers to the proceedings of the Canadian Institute of Mining and Metallurgy and was a member of several other mining and scientific societies.

NEWS OF THE WEEK

Summary

PHELPS DODGE will make additions to its Copper Queen smelter at Douglas, Ariz., that will cost about $1,000,000, according to P. G. Beckett, general manager. Page 1015.

* * *

As soon as a second ball mill is installed and additional chutes are prepared in the mine, Treadwell Yukon will step tonnage at its new Tybo mill up to 350 tons daily. Page 1013.

* * *

Construction of a hydro-electric plant and of a railroad to the coast will be started as soon as possible by Ellyou Goldfields, which is developing the New Guinea field on Edie Creek. Page 1014.

* * *

Tintic Standard has completed installation of the new electric hoist and is now erecting a steel headframe at its Eureka Standard mine, in the Tintic district of Utah. Page 1016.

* * *

North Butte has completed unwatering its Main Range mine at Butte, Mont. Shipments from the Granite Mountain mine are being increased. Page 1016.

* * *

Electrolytic Zinc is completing its new 500-ton zinc-lead mill at Rosebery, Tasmania, which will treat ore from the Hercules group of mines. Page 1015.

* * *

American Smelting & Refining has acquired stock control of East Utah, which owns properties in the Park City district of Utah. Exploration work continues at the company's Mammoth and Silver Reef properties. Page 1016.

* * *

Vertex Mining, subsidiary of Tonopah Mining, will build a mill and tramline at the Buffalo Boy mine, near Silverton, Colo. Page 1014.

The new shaft of Falconbridge Nickel, in the Sudbury district, and its auxiliary buildings that have been put up within the last nine months

Work at Falconbridge Nickel Making a Record for Speed in Construction

Within Nine Months a Complete Camp Has Been Built, a Shaft Sunk to a Depth of 1,000 Ft., With Development Work Under Way, and Erection of a Nickel-Copper Smelter Has Been Started

WITHIN nine months, the Falconbridge Nickel enterprise has accomplished a remarkable amount of work. As late as last October not a sod had been turned on this property, in the Sudbury district of Ontario. At present, a dozen or more permanent buildings have been completed, a station is being cut on the 1,000 level of a new three-compartment shaft, and foundations for a nickel-copper smelter are being laid. The orebody has been reached on the 225 and 350 levels. Development work preparatory to bringing the property into production this fall will be done on the 225 and 1,000 levels.

The Falconbridge property is better known as the old Longyear nickel deposit, having been originally owned and explored by E. J. Longyear and associated interests, of Minneapolis. Falconbridge Nickel Mines was organized last year by the Lindsley brothers, of Toronto. This is the first company to make a determined effort to break into the nickel market, now dominated by International Nickel, since the failure of the British-America Nickel company in 1922. The property is in Falconbridge Township, on the norite-sedimentary contact, 3½ miles from the Garson mine of International Nickel.

During the last month, 4,000 tons of rock were removed from the site of the crusher plant and rock house, south of the shaft. Orders have been placed for a 1,900-cu.ft. Belliss & Morcom compressor, with a capacity of from twelve to fifteen drills, and two Hadfield jaw crushers. The primary crusher is 24x36 in. and the secondary crusher is 18x30 in. Space has been left at the bottom of the shaft for installing additional hoisting equipment, which would permit sinking the shaft to whatever depths development might justify.

Falconbridge's new smelter site is about 2,100 ft. west of the shaft and is on the shore of Boucher Lake. The shaft program was completed approximately a month and a half ahead of schedule, and the smelter preparations are also well ahead. The smelter, although it will start on a basis of 225 tons of ore a day, is designed for 500 tons, with the exception of the blast furnace, which will be equipped for 250 tons. This can be added to when necessary, however. Two Allis-Chalmers converters are on order. The first retaining wall of the smelter, 144 ft. in length, was completed last week, and the foundation for a 175-ft. chimney, foundations for the dust chamber, and

Laying the foundations for the third nickel smelter in the Sudbury district. This plant being built by Falconbridge is expected to start production this year.

the cooling pond have also been finished. Arrangements have been made with the Wahnapitae Power Company for 1,500 hp. for smelter and underground development. Ultimately, 2,000 hp. will be required. The Canadian National Railways, it is learned, is now prepared to provide railroad facilities, and work on construction of an extension of the Garson branch is to start at once. A Leishman cable tramway is on order, to be installed between the shaft and smelter. Two Elliott blowers have been ordered, one for the blast furnace and one for the converters.

With the problem of refining removed through the successful negotiations carried on by Ventures, Ltd., for the purchase of the Kristianssands refinery, in southern Norway, the commercial outlook for the Falconbridge has improved considerably. Along with the refinery, it is understood, goes a ready market for nickel, and success of Falconbridge now apparently depends on two chief factors: first, the factor of cost, on a limited tonnage; and, second, the extent to which the Falconbridge deposit follows certain orebodies of the district and enrichment is found at depth.

Field Work of the Canadian Geological Survey, 1929

W. H. Collins, Director

FIFTY-TWO Geological Survey field parties will be engaged this summer upon surveys and investigations throughout Canada. One party will go to Yukon, two parties to the North West Territories, ten to British Columbia, seven to Alberta, five to Saskatchewan, four to Manitoba, seven to Ontario, nine to Quebec, three to New Brunswick, four to Nova Scotia, and three will be occupied with investigations of general interest. About 250 persons will be employed. Of these only forty are permanent Survey officers. Thirteen are university teachers or specialists obtained from other institutions. One hundred and thirty are students of geology and engineering from the various Canadian universities, who will obtain a useful practical experience in their main study subjects; and, among these, ten will have independent or semi-independent charge of investigations which will be the subjects for their doctorate thesis studies at Canadian and foreign universities. The remainder comprise cooks, packers, canoemen, and other field helpers, mostly whites but including a few Indians and Eskimos.

Although Geological Survey field parties will be distributed throughout Canada, attention will be given particularly to several regions or natural provinces of especial importance from the standpoint of the mineral industry. One of these comprises the eastern and western margins of the Coast Range batholith, a great core of granitic rocks that extends the length of British Columbia and Yukon. This granitic core is largely responsible for the wealth of British Columbia and Yukon in gold, silver, copper, lead, zinc, and other metals, which occur along its edges. Almost the whole program of work in British Columbia and Yukon this year is related to the Coast Range batholith. The foothills of the Rocky Mountains constitute another belt, parallel to the first mentioned and narrower, in which the upturned edges of the stratified rocks that underlie Alberta have exposed mineral wealth of quite a different kind—coal, natural gas, oil, limestone, and other non-metallics. Six out of seven parties in Alberta will work in the foothills. The Pre-Cambrian shield is now well known for the variety and importance of its mineral wealth. Sixteen parties will be scattered through this huge region of nearly two million square miles. Circumstances influencing the distribution of two of these parties are noteworthy. Construction of the Hudson Bay railway to Churchill has already turned the attention of prospecting companies to the Hudson Bay region and rendered it comparatively easy for the Survey to send one field party to an area near Chesterfield Inlet. Another party will be sent by airplane to a mineralized area in northern Saskatchewan that could only be reached by weeks of travel by canoe. A fourth geological province, noted for the variety of its minerals, is the Appalachian-Acadian region of southeastern Quebec, Nova Scotia, and New Brunswick. Nine parties will work there.

U. S. Smelting to Absorb Bingham Mines

THE United States Smelting, Refining & Mining Company has exercised its option to purchase all of the properties and assets of the Bingham Mines Company, owning 1,800 acres of mining land at Bingham, Utah, and the Victoria and Eagle and Blue Bell mines, at Eureka. A total of 50,000 shares of United States Smelting stock is to be set aside to be exchanged for the outstanding 50,000 shares of Bingham Mines Company stock on a share for share basis. This gives the Bingham Mines property a valuation of approximately $2,750,000, estimated on the present market value of United States Smelting stock. Bingham Mines stockholders will vote on the proposed sale of their holdings on June 27.

Under this agreement, United States Smelting practically doubles its holdings in Bingham, besides getting two producers in the Tintic district. Entry through the Mascotte tunnel of the Ohio Copper Company at Bingham will greatly facilitate development of the Bingham properties.

Keeley Development on Upper Levels Still Yielding Ore

DEVELOPMENT WORK on the upper levels of Keeley Mines, at South Lorrain, Ont., is still yielding good mill ore. Production figures for the first quarter do not show the effect of the high-grade ore recently struck on the lower contact. At the end of April, this vein had been drifted on for a length of only 20 ft. Work on the lower contact is being carried on through the shaft of the Frontier mine, the headframe and compressor house of which were recently destroyed by fire. Arrangements have been completed to use the old compressor plant of the Wettlaufer mine to permit continuing work.

Lehi Tintic Near 800 Ft.

Sinking of the Lehi Tintic shaft is nearing the 800 level at its property, in the Tintic district, Utah. Guy W. Crane, Salt Lake geologist, is directing development. The Tintic Empire drift is being advanced steadily. Consolidation of the two mines is practically completed.

The Tybo flotation plant of Treadwell Yukon in Nevada. Below the mill are the machine shop, store rooms, and bunk houses.

Treadwell Yukon Preparing to Increase Tonnage at Tybo

ALTHOUGH the new lead-zinc concentrator of Treadwell Yukon, at Tybo, Nev., has not yet treated more than 200 tons daily, this figure will probably be increased to 350 tons daily as soon as the company can put in more chutes underground and start operation of the second ball mill. The delay in installing chutes, and, therefore, in production underground, resulted from the company's desire not to put ore on the dump when a mill would be available within a short time, according to W. H. Blackburn, manager of the Nevada mines of Treadwell Yukon. Both mining and milling plant have operated smoothly during the first month. Operations started on May 12.

Part of the ore being milled is oxidized, but the recovery is said to be satisfactory, although the percentage has not yet been determined. The ratio of concentration is lead, 13:1, and zinc, 10:1. Lead concentrate contains 65 per cent lead, 3 per cent zinc, 0.09 oz. of gold, and 83.46 oz. of silver per ton. It is shipped to the American Smelting & Refining plant at Selby, Calif., for smelting. The zinc concentrate contains 8 oz. of silver per ton, 50 per cent zinc, and 1 per cent lead. This is shipped to the Sullivan Mining electrolytic zinc plant at Kellogg, Idaho.

Lloyd C. White, of Burch, Hershey & White, San Francisco, designed the plant to treat 250 tons of ore daily, but when the second ball mill goes into operation, probably about June 25, the capacity will be 300 tons and possibly 350 tons daily.

Power for the Tybo operations is supplied by the California-Nevada Power Company. Ore is delivered through the new three-compartment vertical shaft, equipped with a Nordberg hoist formerly used at the Midway shaft of Tonopah Divide, to the receiving bin at the shaft collar. From this bin it is delivered to a grizzly, spaced 4 in., oversize from which goes to an 18x30-in. Blake crusher, set to crush to 4 in. The entire product is carried by a 24-in. belt conveyor to a 3x8-ft. vibrating screen, which takes out $\frac{3}{8}$-in. undersize. The oversize is delivered to a 30-in. sorting belt, where mine wood, steel, and waste will be picked out.

The sorting belt delivers its product to a 4-ft. Symons cone crusher, which reduces the ore to $\frac{3}{8}$ in. This material joins the undersize from the vibrating screen, and both are carried by a 20-in. conveyor belt over a weightometer and thence to the 1,400-ton mill receiving bin.

From this bin, ore is drawn by roll-type feeders to two 8x4-ft. Hardinge ball mills, which grind in closed circuit with two 6x25-ft. Dorr classifiers. Overflow from the classifiers goes to a 24x8-ft. Hardinge thickener and underflow from the thickener goes directly to the lead flotation machine, being automatically sampled en route. The lead flotation machine consists of sixteen 18-in. Minerals Separation cells, directly driven by eight motors with Texrope drives. Lead concentrate from the flotation machine is elevated by a Wilfley pump to a 24 x 8-ft. Hardinge thickener, and thence to a 5 ft. 4 in. by 8 ft. Oliver filter.

From the filter the concentrate is conveyed by an 18-in. belt conveyor to bins and thence by truck to Tonopah. Tailing from lead flotation goes to a Minerals Separation machine, which makes a zinc concentrate. This product is then thickened and filtered in duplicate units of the lead-treatment section.

Ask for Increase in Barytes Import Duty

AN INCREASE from $4 to $8 per ton in the tariff on crude barytes ore was advocated by W. C. Wolf, representing Superior Mineral, of St. Louis, during the hearing, June 18, on the chemical schedule before a subcommittee of the Senate Finance Committee. Mr. Wolf informed the committee that the imported ore is laid down in this country at $11.50 per ton. No increase in the present duty of $4 per ton is carried in Paragraph 69 of the tariff bill as it passed the House.

A request for an increase from 25 per cent to 40 per cent on tungsten and molybdenum chemicals and their transfer from the metals to the chemical schedule was made by V. R. Lansingh, of New York City, representing tungsten and molybdenum refiners.

B. D. Saklatwalla, representing the Vanadium Corporation, Bridgeville, Pa., stated that the rate of 40 per cent ad valorem provided by Paragraph 92 of the House bill on vanadic acid is satisfactory, but he suggested that the organic compounds of vanadium should be mentioned by name.

Sunshine Mill to Handle Larger Tonnage July 1

INSTALLATION of additional equipment at the mill of Sunshine Mining will be completed and the enlarged mill in operation about July 1, according to reports from Wallace, Idaho. Development of ore reserves at the property justified an increase in capacity from 125 to 200 tons daily and has also resulted in an increase in the dividend rate from 12c. to 20c. annually.

During the last year, Sunshine Mining completed a modern boarding house with capacity for 100 men. A new tunnel has been driven 1,500 ft., which will shorten the haul to the mill about 500 ft. and which will also be placed in service about July 1. According to John Sawbridge, president of the company, 700 ft. of ore has been opened on the 700 level and ore is still in both faces of the drift. On the 900 level, this ore has been opened for 600 ft.

North Standard Sinking Winze on Brecciated Zone

Sinking of the North Standard winze, in the East Tintic district of Utah, is being continued in a brecciated zone, lying on a porphyry-limestone contact, which it has continued from the 800 level to below 1,200 ft. Large quantities of gas encountered in sinking made exploration impractical temporarily, but a new blower has been installed to facilitate operations.

Callahan Zinc-Lead Options Dobson Jim Mine

Callahan Zinc-Lead has taken a three-year option on the Dobson Jim property, in the Coeur d'Alene district of Idaho. The property consists of four claims. The main development at the property is a tunnel about 600 ft. long, of which about 500 ft. is said to show ore.

Madrona Starts Dredge

The new gold dredge of the Madrona Gold Dredging Company, above Junction City, Trinity County, Calif., has been placed in operation. It is a 9 cu.ft. wooden-hulled dredge.

Western Exploration Opens Ore at Mammoth Property

DRIFTING on the No. 6 level of the Mammoth mine, of Western Exploration, near Silverton, B. C., has disclosed 4 ft. of galena and 4 ft. of massive mixed lead and zinc sulphides over a length of 50 ft., with the drift still in ore. On this level the shear zone is 20 ft. wide. This ore is the upward extension of that opened for 300 ft. on No. 7 level, where the shear zone averages 25 to 35 ft. Ore in No. 7 level has not been drifted on, but has been opened by a series of crosscuts from a drift on the footwall. A raise has been put up 350 ft. on the dip of the lode on the footwall from No. 7 to No. 6. Owing to the way the lode rolls in and out, a good deal of the raise is in ore. The lode has gradually widened with depth; in No. 4 level it was only 6 ft. across.

The Mammoth adjoins the old Standard mine, which paid its shareholders $2,700,000 in dividends and left some $400,000 undisbursed in the treasury, the interest on which has been used in searching for another mine. Western Exploration bought the Standard mine and equipment last year, and reconditioned the flume and the hydroelectric and compressor plants for use at the Mammoth. When the Mammoth has been brought to production it will explore the Standard at greater depth.

Tonopah Subsidiary to Build Mill Near Silverton

CONSTRUCTION of a mill and a 6,000-ft. tramline is being undertaken at the Buffalo Boy mine, near Silverton, Colo., by Vertex Mining, a subsidiary of Tonopah Mining. The selected mill site has been surveyed, and a contract has been awarded to Hamilton & Gleason, local contractors, to grade and excavate the mill foundation. The route of the tramline has been surveyed by O. H. Metzger, formerly assistant superintendent of the Sunnyside mine of U. S. Smelting, Refining & Mining, and tower construction will be rushed.

The Buffalo Boy is a gold property. Operations at the mine are now being centered on driving of a drift 400 ft. below the main tunnel level. The approximate cost of the construction work which will be undertaken by Vertex Mining is given as $250,000.

Granada Obtaining Good Results at Depth

On the 600 level of the Granada mine, in the Rouyn district of Quebec, the vein has been opened up for a length of about 150 ft., showing a good grade of gold ore over a width of 4 ft. This is the most promising development on the property to date, and it is in a section that had not previously been developed on any other level. Granada is being developed entirely as a gold property, and is in this way distinct from most of the Rouyn mines which carry copper-gold or copper-zinc ores.

About 2,250 Men Employed in "Inco" Expansion Work

BETWEEN construction work on the new smelter at Copper Cliff and the Frood mine development, approximately 2,250 men are employed in pushing ahead the big expansion program of the International Nickel Company in the Sudbury district. These figures are exclusive of the construction crews in the employ of contractors for the Ontario Refining Company, on whose $5,000,000 refinery construction program work is just now getting well under way. The Frood development alone is employing 1,400 men, and approximately 850 men are employed in construction at Copper Cliff. The new smelter stack, which when completed will be 510 ft. high, and the third largest chimney in the world, is rearing itself skyward. Three new electrolytic refinery units are being installed at Port Colborne.

Amity Shipping Ore From Development to Noranda

Amity Copper, operating in the Boston Creek area of northern Ontario, is shipping two more cars of development ore, without sorting, from the 600 level. This is being done to obtain bulk assays from a larger body of ore. Last year Amity made about eight or nine shipments to the Noranda smelter in the Rouyn district. Shipments were suspended so that the shaft might be deepened to 600 ft. and lateral work done to cut the orebody at that horizon.

Montana Lead Buys Mine Once Owned by J. J. Hill

Montana Lead has taken over the Red Mountain group of claims, near Rimini, Mont., which was owned by James J. Hill, founder of the Great Northern Railway. Since his death these properties have been tied up in his estate and no work has been done. T. B. Barbour, of Helena, Mont., and George Norman Slade, of St. Paul, Minn., head the Montana Lead Company, which is driving a new tunnel to tap the orebodies.

Teck Hits Ore at 3,000 Ft.

The Teck-Hughes Gold, in the Kirkland Lake district, has now cut its vein system on the 25th level, a total depth of 3,000 ft. Widths and assays are not yet available, but the management is understood to be pleased with the results.

Will Erect Power Plant for New Guinea Gold Field

MINING TRUST, which controls Ellyou Goldfields Development, has decided to proceed at once with the erection of a hydro-electric power plant at the company's holdings in the New Guinea gold field and with construction of a railroad, the survey for which is now being completed. The Bulolo River, which is 5 miles from the field, will provide sufficient power for all requirements. About 14,000 hp. will be available, and estimates for a hydroelectric plant are now being prepared.

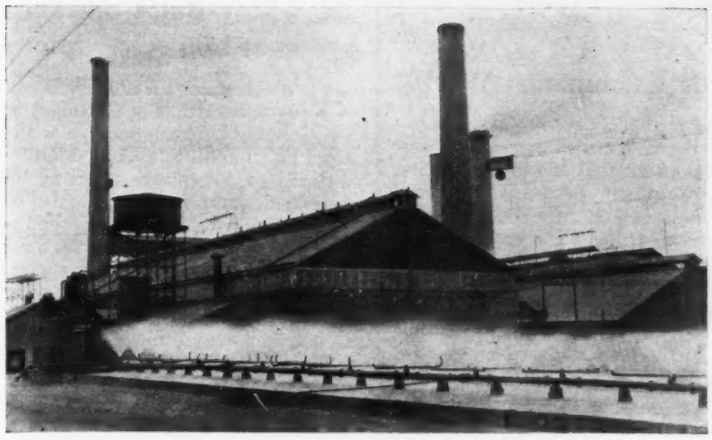
The New Guinea gold field, which was discovered about two years ago, is only 30 miles in a direct line from the coast, but the elevation is 6,700 ft. above sea level, and the vegetation is extremely dense. Natives carrying 50-lb. loads take seven days to traverse 100 miles to the coast by forest tracks at present. Airplanes, which are the principal means of transportation, take only 50 minutes, but the cost is 8d. per pound transported. Construction of a railroad will take until the end of 1931, according to estimates by Arthur Dickinson, consulting engineer for Ellyou Goldfields, and will cost about £250,000. The length will be about 100 miles.

The company's holdings are in two contiguous areas—the Edie Creek area, or plateau, and the Wau area, 3,500 ft. below. Valuable gold reefs have been discovered at about twenty different points. On the plateau, underground work now totals 1,330 ft., showing an average width of 48 in. and an average assay of 77s. per ton, according to Leslie Urquhart, chairman of Mining Trust. These adits have given backs of up to 300 ft., so that already a substantial tonnage has been proved. However, Mr. Urquhart declares this must be regarded as negligible when compared with the possibilities of the whole field. In addition, surface work has been done over a length of 2,850 ft. of reef on the surface, showing an average width of 49 in. and an assay value of 36s.

Work on reefs at the Wau, or lower, area was started much later. However, several lode formations have been discovered so far, the average of five being 44 ft. in width, assaying 53s. per ton. In addition, the company has available in its alluvial workings about 2,500,000 cu.yd. of gold-bearing material, averaging 12s. per cubic yard. Production from this source between October, 1926, and December, 1928, was 263,654 oz. of gold.

Benmore to Operate Mines Near Tooele, Utah

Benmore Consolidated Mines will develop several Harker canyon properties in the Columbia mining district near Tooele, Utah. Mines included in the consolidation are the Sharp Lead, the Sunday, and the Caldwell claims, totaling 900 acres. The Smith tunnel is being retimbered preliminary to advancing it further into the formation.



The Phelps Dodge smelter at Douglas, Ariz., with water-cooling installation in foreground

Copper Queen Smelter Making Changes That Will Cost About $1,000,000

Anode Casting Equipment, Similar to Installation at Clifton, and New Crushing, Sampling, and Bedding Plant Will Be Added by Phelps Dodge to Its Branch at Douglas, Ariz.

ADDITION of an anode casting plant and a new bedding and preparation plant to the Copper Queen smelter of Phelps Dodge, at Douglas, Ariz., will cost about $1,000,000, according to an announcement made by P. G. Beckett, general manager of the company. The anode casting plant will probably be along the same lines as that at the Clifton smelter of the company, and is being undertaken because of the construction of a new copper refinery at El Paso, Tex., by Nichols Copper, Phelps Dodge, and allied interests. Shipment of copper in the form of anodes, instead of the usual blister bars, will save melting and casting at the refinery. Mr. Beckett's statement on the new improvements follows:

"Plans have been formulated and approved for expending close to $1,000,000 in improvements within the next year at the Copper Queen reduction works at Douglas.

"The largest part of this money will be expended on a crushing, sampling and bedding plant. This department in the smelter is known as the preparation department and puts the ores and fluxes in proper condition for roasting and smelting. The present preparation department is practically as old as the smelter itself, and very few changes have been made in it since its original design. The new plant that will take its place will crush the ore very much finer than the present equipment can, and, in general, the ores and concentrates will be handled by more mechanical methods than at present possible.

"The bedding plant will consist of five stalls, 40 ft. wide and 200 ft. long, and each stall will hold 11,500 tons of mixed ores and concentrates. The material will be fed to any bed desired from an overhead conveyor and a reclaiming machine will reclaim the material from the stalls and deliver to a belt leading to the roaster plant.

"The location of this new crushing, sampling and bedding plant will be northeast of the converter building, and the entire installation will be very much closer to the furnaces than the present plant. The cost of this new installation will be somewhat over $750,000.

"The other new improvement at the Douglas reduction works, which is estimated to cost somewhat over $150,000, will be an anode plant. At the present time the Copper Queen reduction works ships its output as blister copper in bars which, when they reach the refinery, have to be remelted before being cast into anodes. The smelter in its new plant will cast anodes direct, thereby eliminating the remelting at the refinery. This anode plant will be installed at the north end of the present converter aisle.

"Shipments of anodes from the smelter are expected to be made as soon as the new refinery at El Paso is complete, which, as at present estimated, will be about the end of the present year.

"Of these two construction jobs, the anode plant will be completed first, and the preparation plant will probably not be completed until the early part of next year. Neither job will call for a great number of additional men, on account of the designing and field work being spread over a period of about nine months."

Build 300-Ton Mill at Chase Mine, Near Prescott

Construction of a 300-ton selective flotation mill has been started at the Chase mine, in the Senator district of Arizona, south of Prescott. At a recent meeting of the board of directors R. G. Chase, of Prescott, was re-elected president and $300,000 was appropriated for building the mill and for development work in the mine. High-grade zinc ore, 4 ft. wide, is reported to have been struck in crosscutting.

Altar & Cananea Cleaning Shaft at Copper Prince

WORK of cleaning out the main shaft at the Copper Prince property, one of a group of six claims owned by Altar & Cananea Mining about four miles south of the American-Mexican boundary, near Tucson, Ariz., has reached a depth of 150 ft. This operation will be continued, and the shaft will probably be deepened to 500 ft. A winze has been sunk from a crosscut near the Smelter shaft on this property, and 12 ft. of high-grade ore has been cut. A 70-ton blast furnace was formerly operated on this property, but the present company believes that a larger plant is justified.

Dr. Frank T. Hogeland, chief surgeon of Greene Cananea, is president of the Altar & Cananea, and other Greene Cananea officials, including William Catron, superintendent, and N. C. Thompson, chief of the employment department, are directors. The company also owns three other claims about 20 miles south of the Copper Prince.

Electrolytic Zinc Finishing Mill at Rosebery, Tasmania

CONSTRUCTION of a 500-ton mill at Rosebery, Tasmania, is nearing completion, according to recent reports from Australia. Electrolytic Zinc is building this plant to treat lead-zinc ore from the Hercules mines, about 5 miles from Rosebery. These properties were purchased from the Mount Read & Rosebery Mines, Ltd., in 1920, and for several years Electrolytic Zinc has been operating an experimental plant at Zeehan to test this ore.

Ore will be delivered to the mill from the mines by means of a cable tramway. Concentrate will be shipped over the Emu Bay railroad to Burnie, where large storage bins will be built to store the concentrate for shipment to Risdon, near Hobart, Tasmania.

Seneca Copper Increasing Scale of Operation

PRODUCTION from Seneca Copper has increased sufficiently to keep one stamp head at its mill, in the Michigan copper district, in constant operation and another head in commission half time. The Fahrenwald flotation unit in the stamp mill is yielding good results, and eventually all heads in the mill will be similarly equipped.

High-grade ore is coming from the bottom levels of No. 1 shaft and from the 17 and 18 levels of No. 2 shaft. The 3 level drift north from No. 1 shaft is in good ground about 1,000 ft. north of No. 2 shaft. Sinking to the 10 level is under way in No. 1 shaft. After this level is reached, a plat will be cut and a crosscut driven to the vein, which is estimated to be 85 ft. distant at this point.

New Hoist Now Installed at Eureka Standard Mine

INSTALLATION of the new Wellman-Seaver-Morgan electric hoist has been completed at the Eureka Standard mine, of Tintic Standard Mining, in the Tintic district, Utah. However, considerable surface work must be completed before ore can be handled through the Eureka Standard shaft. The old gallows frame is being used at present while a new steel headframe is being erected. In the meanwhile, shipments of ore are being made through the Tintic Standard shaft, which is connected underground with the Eureka Standard workings.

Sinking of the shaft is now very near its objective of 1,300 ft. At last report it had reached the 1,250 level. Extension of a spur from Dividend to the Eureka Standard shaft by the Denver & Rio Grande Western railroad is being considered. The distance is about a mile.

Strike Ore North of Beck Fault in Chief Con. Ground

OPERATIONS on the 1,400 level of the Prescott-Piatt lease have opened up the first sizable orebody found in Chief Consolidated ground north of the Beck Fault, in the Tintic silver-lead district, Utah. Other companies have produced from ground north of the Beck Fault, but Chief Consolidated has never had that fortune heretofore. The stope has been opened up for a width of four sets and a height of five sets. The ore is carbonate and is netting from $1,000 to $1,700 a carload after smelter and railroad deductions.

In the eastern part of the district, Chief Consolidated has developed the extension of its Eureka Lilly orebody from which it has produced in the upper levels on its 750 level. This ore has been drifted on for 40 ft. and for a width of 20 ft., according to Cecil Fitch, general manager of the company, without finding the limits. Crosscutting is now being done on the 800 and 1,200 levels to reach this orebody.

A. S. & R. Obtains Control of East Utah, at Park City

STOCK control of East Utah Mining, owning properties in the Park City district, Utah, has been acquired by American Smelting & Refining for the purpose of a geologic examination, according to A. H. Means, manager of the western mining department of the company. East Utah intends driving on a promising lead in the Hawkeye-McHenry shear zone, with which the Park Utah Consolidated orebody is associated. American Smelting & Refining also recently acquired extensive properties in this district near the Silver King Coalition mine.

In addition, the company is continuing work at the Silver Reef mine, near St. George, Utah, where a shaft has been sunk to 300 ft. Crosscuts are being driven on the 300 and 460 levels. About 250 ft. are being driven monthly. At the California shaft of this property, a Cameron No. 9 pump has been installed and the shaft is being unwatered for exploratory work.

On the west shore of Great Salt Lake, about 60 miles from Salt Lake City, American Smelting & Refining is developing a low-grade silver-lead property, known as the Monarch mine. A shaft is being sunk to check results of geophysical surveying.

C. M. & S. Uses Plane for Examination Work

RECENTLY, W. M. Archibald, manager of mines for the Consolidated Mining & Smelting Company of Canada, made his first trip in an airplane, when he went from Vancouver to the Old Sport mine, at the northern extremity of Vancouver Island, made his examination, and returned in the same day. By the old method the trip and examination took from seven to ten days. This converted him to the value of the airplane for his work, and he now has purchased a Moth plane. Consolidated is leveling a field at its Warfield experimental farm, near Trail, for his use.

Main Range Shaft of North Butte Completely Unwatered

AT the Main Range property of North Butte Mining, in the eastern part of the Butte district, the shaft has been unwatered to the bottom, or 2,200 level, and a new lead-covered cable is being strung from surface to the bottom. A 10-in. pipe is being installed for pumping from the 1,200 level to the bottom, where a 16x18-ft. station is being cut. Two electric plunger pumps, each having a capacity of 1,200 g.p.m., have been ordered.

Shipments from the company's Granite Mountain mine totaled 4,650 tons of copper ore during May, and this will probably be increased to about 6,500 tons this month. The company is employing about 300 men at both its properties. Two orebodies have been struck at the Granite Mountain, of which one is virgin. About midway between the Granite Mountain and Speculator shafts a crosscut was driven in a southerly direction and cut a vein 6 ft. wide, of which 2 ft. was high-grade ore. Drifting east and west along the vein is now being done. The other orebody has been found north of the shaft between the 2,000 and 2,200 levels, and is a continuation of an orebody that was mined before the property was closed. This ore is 8 ft. wide.

May Build Smelter at Lois River Site

AT the request of Consolidated Mining & Smelting of Canada, the British Columbia government has withdrawn from location all unalienated land within an area of 30 squares miles around the proposed site for the hydro-electric station on the Lois River, pending the decision of the Provincial Water Board as to the granting of water rights on this river, for which both Consolidated and the Powell River Paper & Pulp Company have applied.

Though no official reason for the granting of the reserve has been made public, the belief is that the land is for a copper smelter and refinery in the event Consolidated is granted the water right. The large area sought would be to prevent subsequent litigation for damages from smelter fume, and the object of the reserve is to prevent speculators from buying the land before the Water Board reaches its decision. The site would be an ideal one for a smelter; it is about 60 miles by water from the Nanaimo coal field and ample low-grade siliceous copper ore and high-grade limestone for fluxing purposes are available near at hand on Texada Island.

Change Butte Madison Mill to Flotation Methods

INSTALLATION of an eight-cell Minerals Separation flotation machine is now being made in the Butte Madison mill, at Rochester, Mont. This will make the capacity of the plant 60 tons daily, from which about 15 tons of concentrate will be produced. Power for the mill is obtained from a 75-hp. Diesel engine. With the addition of flotation to the treatment, the ore will go through the following process: Crushing will be done in a Colorado Iron Works crusher and a 5x4-ft. ball mill of the same make. After classification the coarse product is passed to three James tables and the fine product to the flotation department. A car of table concentrates was recently shipped which assayed 27.4 per cent lead, 4 per cent zinc, $5.40 in gold, and 16.9 oz. of silver to the ton. Increases may be made in the capacity of the concentrator at a later date.

New Nickel-Copper Find Reported in Saskatchewan

A new find of copper-nickel ore is reported in the district lying between Lac La Ronge and Rottenstone Lake, in northern Saskatchewan. The ore is pyrrhotite, carring disseminated chalcopyrite and nickel. Engineers for Consolidated Mining & Smelting and Dominion Explorers are now understood to be on the ground. Consolidated now has a drilling outfit exploring a nickel-copper deposit on the shore of Rottenstone Lake, but the prospectors who discovered the latest find declare it larger than the Rottenstone Lake deposit.

Societies, Addresses, Reports

Buyers and Sellers of Tin Discuss Market at Association Dinner

AN INFORMAL dinner of the American Tin Trade Association was held Wednesday evening, June 12, at the Planters Restaurant, New York, attended by about 100 members of the trade, including the representatives of many of the large consumers throughout the country, there being an especially good representation of the tinplate industry. C. S. Trench presided and said that the dinner represented the first general gathering of buyers and sellers of tin that has ever been held in this country, and that it was the hope of the present officials of the association that it will become an annual event. In fact, it is the carrying out of one of the purposes for which the association was formed—namely, to foster a frank and friendly intercourse among its members.

"As I see it," said Mr. Trench, "the association represents to the tin trade what the rules committee does to the golfers—it cannot remove the hazards or widen the fairway, or make the course easier, but it can and does see that fair rules shall apply and be observed by all. The market rewards those who either by good skill or good fortune keep out of the bunkers and brooks, and penalizes those of us who foozle their drives and end by missing short puts. It cannot be otherwise, but it can be seen to that all play the game fairly.

"Probably one of the most aggravating things about the tin game is that the course is constantly being altered and rearranged, and, if we are to believe current rumors, a certain group is undertaking an entirely new layout. Hitherto the tin links has been a free affair, which, though possessing certain advantages, has also had its drawbacks, in that some of the players have apparently felt no interest in preserving the course in good condition for the benefit of those who follow after. It remains to be seen whether a new management will displace the old management, and whether the playing conditions will be any better than they are now. Meanwhile, the old struggle to beat Colonel Bogey is carried by both buyers and sellers with zest and occasional satisfaction."

A. B. Parsons, who, a year ago, when most of the trade was thinking of tin prices in the 50's and 60's, furnished a striking summary and forecast under the caption "Is 45-Cent Tin Likely," gave an interesting address, and in summing up the situation he stated four conclusions that he had reached:

1. Left to its own devices and viewed from the standpoint of statistics, the outlook for the tin market during the remainder of 1929 is for little advance in prices and a probable decline.

2. If the London "group" continues to take metal out of the market, the statistical position may be kept from further deterioration, but the effect on sentiment of the knowledge that this is being done will tend to offset the advantage gained.

3. The formation of an effective association of producers, if accomplished, should "stabilize the industry"—a euphoneous phrase which may be translated as "advance the price."

4. The prevailing unfavorable market doubtless has had, and will have, the effect of dampening enthusiasm for the installation of new dredges and other equipment, so that, with a steady increase in consumption, the outlook for the future—say two or three years hence—is good.

J. W. Furness, Chief of the Minerals Division of the U. S. Department of Commerce, made a plea for research on pig tin. He called attention to the fact that no effort has been made to increase the use of tin, as has been done for other metals, particularly mentioning nickel as an example. He pointed out that after the war the consumption of nickel dropped 40 per cent, but as a result of scientific research and efforts to extend the use of nickel a phenomenal increase in the consumption has occurred during the last year.

John Hughes, of the U. S. Steel Corporation, which is the largest consumer of tin in the world, made an interesting address. He said among other things that the Steel Corporation always bought tin for future delivery in the primary markets, and although this policy, on account of the decline in tin, resulted in a high cost on supplies at present being received, still, in his view, it was the only safe policy that the company could pursue. He called attention to the dangers of consumers' not making provision for their future requirements and said that a hand-to-mouth policy is more or less dangerous to any consumer using substantial tonnages. He took occasion to pay a tribute to the importers, dealers, and brokers who supply tin to the consumers and said they were worthy of the support of the trade generally. He said the Steel Corporation is in favor of broad markets and free competition, and he welcomed the formation of the American Tin Trade Association, not only for its value as a factor for sure and fair practices in the trade, but also for making frank and friendly intercourse among all interests connected with this important and essential metal.

W. F. Kemble, of Patiño Mines & Enterprises, gave some interesting facts regarding tin mining in Bolivia and especially as regards the Patiño interests, which produce nearly one-half the Bolivian output. He stated that the company's activities are confined to producing the concentrates, and its policy is to sell them as quickly as produced to the smelters in England and on the Continent, at current market quotations. The evening closed with the showing of moving pictures of tin mining in Bolivia by the courtesy of the Patiño company.

Dr. Bain Describes Recent Visit to Colombia

DR. H. FOSTER BAIN, secretary of the American Institute of Mining and Metallurgical Engineers, spoke on Thursday, June 13, before the New York section, A.I.M.E., giving some impressions gained on his recent trip to Colombia, South America, from which he had just returned. Dr. Bain went to Colombia late in March as the United States representative on an international committee to devise new oil legislation for that republic. His talk was devoted largely to a general description of Colombian customs, racial and sociological characteristics of the inhabitants, geological and geographical conditions, and recent economic and legislative trends. From a standpoint of the economic geology of the non-ferrous metals, Colombia has so far been important only as a producer of gold and platinum.

The attendance was the largest at any recent meeting of the New York section. Incidentally, it was held in the clubrooms of the Building Trades Employers' Association, on the 26th floor of the Park Avenue Building, at 2 Park Avenue. This new meeting place created a favorable impression on the members. R. M. Roosevelt, chairman of the section, announced that in the future all section meetings would be held there.

Institute of Metals to Meet in Germany

A LARGE attendance is promised at the forthcoming German meeting of the Institute of Metals. To be held in Dusseldorf on Sept. 9-12, this will be the first meeting of the Institute to take place in Germany. The conference is being held by invitation of the Verein Deutscher Ingenieure and of the Deutsche Gesellschaft fur Metallkunde. Though participation in the meeting will be limited to members of the Institute, non-members desirous of taking part can be elected—provided that their qualifications are satisfactory—in time to take part in all the proceedings at Dusseldorf, if their applications are received not later than July 4 by the secretary, G. Shaw Scott, 36 Victoria St., London, S. W. 1., England.

MARKET AND FINANCIAL NEWS

June Dividend Total Establishes a New Record

THE TOTAL of American mining company dividends disbursed in June continued the record-breaking achievements of recent previous monthly totals. Not only does this month's total constitute a new record for the month of June by a margin of approximately $14,000,000, or 43 per cent, but it exceeds also the record total for any previous individual month—that of December, 1928—by about $3,000,000, or 7 per cent. Again, as in the establishment of other monthly dividend records recently, increased disbursements by the copper companies account largely for the tremendous gain, though the iron mining and steel manufacturing company dividends have begun to show some improvement as a result of the sustained high rate of operations in that branch of industry.

Compared with the list for June, 1928, the following copper companies reported larger dividend rates this month: Calumet & Arizona, Calumet & Hecla, Mohawk, Mother Lode Coalition, Nevada Consolidated, Isle Royale, Nichols Copper (actual distribution in May), Tennessee Copper & Chemical, Utah Copper, and Chile Copper. As a result of financial readjustments effected during the last year, the total of dividend payments by American Metal, and International Nickel of Canada, both companies with some copper production interest, is appreciably greater than a year ago. Inland Steel reports a substantial increase in its regular quarterly dividend payment, and Cleveland-Cliffs Iron announced a special disbursement that, altogether, improved the iron-mining company dividend total measurably. Among the miscellaneous mining companies, Dayrock Mining, Coeur d'Alene silver-lead producer, appears in the June list for the first time; General Development, the Lewisohn holding company, announces a resumption of dividends after an absence of more than a year; and Utah-Apex, producer of silver, lead, zinc, and copper in the Bingham Canyon district, Utah, an irregular payer of dividends, contributes a distribution of 25c. per share this month, the first of record since August, 1928. Hecla and Sunshine Mining companies, Coeur d'Alene silver-lead producers, report larger payments than in June, 1928. Smaller dividends were paid by Hollinger Consolidated Gold, of Ontario, and by Lucky Tiger-Combination, producer of miscellaneous metals in Sonora; Golden Cycle Mining & Reduction, Rico Argentine, Sidney Mining, and United Gold Mining appear to have passed their dividends regularly due in June, as indicated by last year's list.

The closing month of each quarter is a popular choice for disbursements to shareholders, and that fact is partly responsible for the concentration of dividend payments by mining companies in the months of March, June, September, and December. In other words, the unusual size of this month's total is the reflection of a periodic condition rather than the culmination of any major economic trend. Based upon current statistical analyses of the general business situation, and assuming that most mining companies are reflecting peak or close-to-peak earnings in their current dividends, it appears likely that quite a few months will elapse before the remarkable total of $47,496,000 for mining dividends in the month of June, 1929, will be exceeded.

E.&M.J. Compilation of Mining Dividends and Yields for June, 1929

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
American Metal	U. S. and Mex.	$0.75 Q	$484,947	5.4
American Metal, pfd.	U. S. and Mex.	1.50 Q	150,000	5.2
American Smelting & Refining, pfd.	U. S. and Mex.	1.75 Q	875,000	5.3
Bunker Hill & Sullivan, s, l	Idaho	0.75 MX	245,250	6.5
Butte & Superior, z, s	Mont.	0.50 Q	145,099	25.4
Calumet & Arizona Mining, c	Ariz.	2.50 Q	2,107,142	7.8
Calumet & Hecla Consolidated, c	Mich.	1.00	2,005,502	9.2
Cleveland-Cliffs Iron	Mich.	5.00 X	2,000,000	....
Dayrock Mining, s, l	Idaho	0.03 Q	50,750	4.8
Federal Mining & Smelting, pfd., s, l, z	Idaho, Okla.	1.75 Q	126,000	3.2
General Development, h	Various	0.25 A	31,250	....
Hecla Mining, l, s	Idaho	0.25 Q	250,000	5.8
Homestake Mining, g	S. D.	0.50 M	125,580	9.3j
Inland Steel	Minn.	0.875 Q	1,034,950	3.9
Isle Royale, c	Mich.	0.50 Q	75,000	8.5
Mohawk Mining, c	Mich.	1.50 Q	172,500	10.8
Mother Lode Coalition, c	Alaska	0.20 SA	500,000	11.9
National Lead	U. S.	1.25 Q	387,289	3.5
National Lead, pfd., "A"	U. S.	1.75 Q	426,433	5.0
Nevada Consolidated Copper	Nev., Ariz., N. M.	0.75 Q	3,641,332	6.5
New Jersey Zinc	Various	0.50 X	981,632	....
Nichols Copper	N. Y.	0.75 SA	52,500	....
Republic Iron & Steel	U. S.	1.00 Q	300,000	4.4
St. Joseph Lead, l, z	Mo., N. Y.	0.75 QXX	1,462,821	4.4
Sloss-Sheffield Steel & Iron	Ala.	1.50 Q	150,000	10.1
Sunshine Mining, c, s, l, z	Idaho	0.05 Q	75,000	6.6
Tennessee Copper & Chemical	Tenn.	0.25 Q	198,656	5.4
Texas Gulf Sulphur	Texas	1.00 Q	2,540,000	5.5
Tintic Standard, s, l, c	Utah	0.30 XX	345,994	9.9j
U. S. Steel	U. S.	1.75 Q	12,453,411	4.2
Utah Apex, s, l, c, z	Utah	0.25 K	132,050	13.3j
Utah Copper	Utah	4.00 Q	6,497,959	5.5
Companies in Other Countries				
Chile Copper	Chile	0.875 Q	3,863,560	4.0
Hollinger Consolidated Gold	Ont.	0.05 FW	246,000	10.8
International Nickel, n, c	Ont.	0.20 Q	2,751,600	1.7
Lake Shore, g	Ont.	0.20 QX	200,000	4.3j
Lucky Tiger-Combination, g, s	Sonora	0.05 M	35,789	15.0
McIntyre-Porcupine, g	Ont.	0.25 Q	199,500	6.1
Mining Corp. of Canada	Ont.	0.125 SA	207,560	5.8
Patino Mines & Enterprises, t	Bolivia	45s	£276,063	....
Total			$47,496,806	

s, silver; l, lead; z, zinc; c, copper; g, gold; n, nickel; t, tin; Q, quarterly; SA, semi-annually; M, monthly; MX, monthly 25c., extra 50c.; R, resumption; K, irregularly; X, extra; FW, every four weeks; QX, 10c. regular quarterly and 10c. extra; QXX, 50c. regular quarterly and 25c. extra; XX, quarterly 20c. extra 10c.; j, based on dividends for past twelve months.

MEXICAN CORPORATION, LTD., reports for the quarter ended March 31, 1929, that its Fresnillo unit mill crushed and treated 203,362 tons of oxidized ore and 47,360 tons of sulphide ore, a total of 250,722 tons, with the following financial results:

Value of bullion and concentrates produced	$1,318,473
Working expenses	942,424
	$376,049
Miscellaneous profit	8,765
Total revenue, after development but before depletion and depreciation	$384,814
Proportion accruing to The Mexican Corporation, S. A., of total revenue, before depreciation	193,151
Mexico City office expenses	7,763

During the period the Teziutlan unit mill treated 16,890 tons of sulphide ore with the following results:

Value of concentrates produced	$212,642
Working expenses	174,307
	$38,335
Miscellaneous profit	7,198
Total revenue, after development but before depreciation	$45,533
Proportion accruing to The Mexican Corporation, S. A., of total revenue, before depreciation	22,767

Nipissing Reports Higher Earnings

THE annual report of Nipissing Mining Company, Ltd., shows net profit of $406,440 in 1928, compared with $347,058 in 1927.

Statement of Operations for 1928

Gross settlements:		
Bullion, residue and ore shipments		$1,177,558
Gross value of ore, bullion and residue at mine Dec. 31, 1928.		797,046
		$1,974,605
Less gross value of inventory at mine Dec. 31, 1927	$808,989	
Gross value of custom bullion.	2,195	811,184
Gross value of 1928 Nipissing production		$1,163,420
Cost of mining and all other expenses (including smelter deductions and treatment on settlements of 1928 ore and accrued charges on ore, bullion and residue at mine)	$815,819	
Less other income at Cobalt	8,932	
Net cost of production		806,887
Net income from 1928 production		$356,533
Add interest on bonds	$103,870	
Interest on bank balances	24,696	
Profit on sale of securities	1,604	130,170
		$486,704
Less cost of work on outside properties		80,263
Net profit		$406,440
Surplus, Jan. 1, 1928		3,685,987
		$4,092,427
Less dividends declared and paid during 1928	$300,000	
Dividend payable Jan. 1929	90,000	390,000
Net surplus		$3,702,427

General operating results at Cobalt were somewhat more favorable than for the previous year. Production of silver was 1,909,882 oz., a slight increase over 1927. Costs were reduced by 4.6c. per ounce of silver produced. There was a decrease of 15,000 tons treated at the low-grade mill, but the head assay was 30.68 oz. per ton as against 23.65 oz. in 1927. Shipments for the year contained 1,091,899 oz. silver. Total production to date is in excess of 81,000,000 oz. There was a decrease in the amount of underground work, as a result of the fact that many portions of the property have now been fully explored. Stoping operations were confined to a number of open cuts and small veins. Known ore reserves amount to 17,000 tons, containing 596,000 oz., a decrease of about 90,000 oz. from the preceding year.

In the absence of any discovery of major importance to replace the production from "19" shaft, production for 1929 is not expected to equal that of 1928. Continued favorable development was encountered at "19" shaft, where the vein discovered early in 1928 developed in a satisfactory manner at both the 100 and 150 levels, particularly the former. A large part of the year's production came from this vein. More recently, another vein in the same vicinity was located, but it does not compare in importance with the main vein. There were also additional discoveries of modest size at "28" tunnel and in the vicinity of the older workings at "49" hill. Operations on the town side of the lake continued throughout the year, but the production obtained was mainly mill "rock."

At South Lorrain, work in the conglomerate in the southern part of the property was disappointing. A number of small calcite veins containing low assays in silver were encountered, but none was important. Several diamond-drill holes were completed under Lake Temiskaming without favorable results. Stoping operations were concluded in the fall. Production in 1928 amounted to 65,000 oz. silver and one car of cobalt ore. Shipments to date have contained 240,000 oz. of silver and 135 tons of cobalt ore. In addition, about 120,000 oz. of silver are contained in a mill dump, of no value at the present price of silver. All operations at South Lorrain ceased in the early part of 1929.

Production costs were 42.248c. per ounce of silver, $12.689 per ton of ore, compared with 46.81c. per ounce and $11.23 per ton in 1927.

THE MEXICAN CORPORATION, LTD., reports that the negotiations for the merging of interests of the Fresnillo Company (owners of the Fresnillo mine) and The Mexican Corporation, S. A. (lessees of the mine) have been completed. Formal agreements giving effect thereto were signed in New York early in May. In the course of negotiations it was decided to enlarge the capital of the existing Fresnillo company instead of forming a new Canadian corporation as was originally intended. As a result of the merger the Fresnillo company now has an authorized capital of one million shares of no par value, half of which will be issued to The Mexican Corporation, S. A., for surrender of its lease of the mine (15½ years unexpired) and $300,000 of working capital. The remaining 500,000 shares will be issued to the existing stockholders of the Fresnillo company in replacement of their common stock of that company.

Yukon Gold Had Net Profit of $389,184 Last Year

Yukon Gold Company, Guggenheim subsidiary, operating tin mines and dredges in the Malay Peninsula, the Elkoro mines, at Jarbidge, Nev., and the Keno Hill property, in Yukon Territory, reports a consolidated net profit of $389,184 on its 1928 operations.

Statement of Income for 1928

	Production	Working Cost (Including Royalties)	Operating Gain
Malay dredges	$1,494,914	$746,339	$748,575
Malay tributes	47,281	.....	47,281
Total operations	$1,542,195	$746,339	$795,856
Non-operating income			
Interest on Elkoro Mines Company notes		$104,337	.....
Interest on bank deposits, and call loans		62,472	$166,810
Total income		.....	$962,666
Less:			
New York general expense and taxes		$24,905	.....
Examination expense		6,271	.....
Interest on Yukon-Alaska trust notes		252,332	.....
Depletion of properties		58,961	.....
Depreciation of equipment		224,817	.....
Miscellaneous		6,192	573,481
Net profit for 1928		.....	$389,184

Late in 1928 the trustees decided to terminate the Yukon-Alaska trust. This was accomplished early in 1929, and the assets were turned over to the Pacific Tin Corporation.

Record Malayan Tin Output in 1928

MALAYAN statistics show the production of 64,459 tons of tin in 1928, of which 61,935 came from the Federated Malay States. According to Frank C. Lee, American Consul General at Singapore, this is the largest production ever recorded for this area. Only a small percentage of the total Malayan output is produced outside of the Federated States. Since 1893, the earliest year for which accurate statistics are available, the Federated Malay States have produced a total of 1,630,735 tons of tin, the annual output growing almost steadily from 39,912 tons in 1893 to the record production of 1928. The actual value of the total production cannot be ascertained, but estimation from the average annual tin price of each year places it at £276,746,275.

ZINC CORPORATION LTD., Broken Hill, New South Wales, reports its production for March, as compared with the returns for the two previous months, as follows:

	Jan.	Feb.	Mar.
Mill run, hours	520	517	535
Ore treated, tons	23,611	23,366	23,473
Assaying			
Lead, per cent	15.3	15.5	15.5
Zinc, per cent	10.3	11.4	10.7
Silver, oz.	3.2	3.4	3.8
Lead concentrates, tons	5,073	5,084	5,331
Assaying			
Lead, per cent	66.7	66.4	64.5
Zinc, per cent	6.1	6.3	6.8
Silver, oz.	13.4	14.0	15.2
Zinc concentrates, tons	4,188	4,763	4,310
Assaying			
Lead, per cent	3.8	3.7	3.0
Zinc, per cent	48.1	47.6	48.0
Silver, oz.	1.3	1.3	1.30

PHELPS DODGE CORPORATION listing report to the New York Stock Exchange gives copper ore reserves at the different mines in the Southwest that it owns as follows:

	Moctezuma		Morenci		Copper Queen	
	Tons Ore	Per Cent Copper	Tons Ore	Per Cent Copper	Tons Ore	Per Cent Copper
Jan. 1, 1929	3,499,600	2.71	111,211,800	1.44	20,657,241	1.86
Jan. 1, 1928	3,318,600	2.69	112,914,500	1.45	22,013,242	1.94
Jan. 1, 1927	3,261,500	2.73	113,456,700	1.46	22,996,445	1.98
Jan. 1, 1926	3,504,600	2.84	112,329,600	1.46	25,089,218	2.07
Jan. 1, 1925	3,583,500	2.92	108,363,900	1.45	27,351,401	2.04

Ore reserves of the Burro Mountain group are given as 11,725,381 tons, averaging 1.94 per cent copper Jan. 1, 1929, with no statements as to ore reserves at earlier dates.

Mason Valley Mines Reports Net Profit of $371,739

Operating results of the Mason Valley Mines Company for 1928 are shown in the following tables:

Income and Expense Statement

For 1928

Sales of copper		$2,501,074
Cost of sales:		
Inventory of metals, ores and concentrates, Jan. 1, 1928	$930,600	
Operating expenses	$2,468,757	
Depreciation	108,449	
	$2,577,206	
Less—Gold and silver sales	522,890	2,054,316
	$2,984,916	
Inventory of metals, ores and concentrates, Dec. 31, 1928	887,619	2,097,297
		$403,777
General administrative and engineering expenses		45,351
		$358,425
Interest and other income		15,229
		$373,655
Other deductions: Interest paid		1,915
Net profit		$371,739

Surplus Account

For the year ended Dec. 31, 1928

Deficit—Jan. 1, 1928	$193,141
Profit for year	371,739
Surplus—Dec. 31, 1928	$178,597

A total of 132,518 tons of marginal ore was smelted, of which 80,798 tons was from the company's properties and properties worked under lease and 51,720 tons from outside sources. From the above ores there was produced 16,831 oz. of gold, 251,088 oz. of silver, and 17,334,240 lb. of copper.

Zinc Research Plans Formulated

R. M. ROOSEVELT, vice-president of Eagle Picher Lead Company and president of the American Zinc Institute, has announced plans for the formation of a Zinc Research Corporation, a separate body, which will carry out the development work along lines proposed at the annual meeting of the organization in April.

Mr. Roosevelt is chairman of the committee appointed to organize the Zinc Research Corporation. The other members are A. P. Cobb, vice-president of New Jersey Zinc Company; J. A. McCarthy, of United Metals Selling Company; B. N. Zimmer, of American Metal, and John A. Robinson, of Commerce Mining & Royalty Company. The understanding is that the corporation will be financed through subscriptions at the rate of 25c. per ton by members producing slab zinc and 12½c. per ton by zinc concentrate producers. The information and research results developed by the corporation will be confidential to the members.

Plans for the research and trade extension work, expected to be mailed to members of the American Zinc Institute in the near future, will be governed in their scope by the extent to which the members of the industry cooperate in the movement.

It is expected that at first the corporation will start work on an exhaustive survey of the prospective market for zinc. Early consideration of this plan brought out estimates of a cost totaling at least $50,000 for such a preliminary survey, whereas extensive research and a market broadening plan would cost approximately $300,000 a year, equal to about 50c. per ton of zinc produced.

Greene Cananea Reports Net Income of $1,974,047 in 1928

Greene Cananea Copper Company shared in the general prosperity of the copper industry in 1928. Net income of the company totaled $1,974,047, as shown in the accompanying report.

Combined Income Account for 1928

Income:		
Sales of metals		$5,856,256
Miscellaneous receipts		163,777
Total		$6,020,033
Expense:		
Mining and reduction	$2,588,987	
Refining and selling	648,407	
Administration and income taxes	219,892	
Metals in process and on hand at beginning of year	855,354	
Total	$4,312,641	
Metals in process and on hand at end of year	567,216	3,745,425
		$2,274,608
Depreciation		423,090
		$1,851,518
Interest received		99,205
		$1,950,723
Income from investments		23,324
Balance, net income of the year, carried to foregoing balance sheet		$1,974,047

The company's mines produced during the year 36,420,009 lb. copper, 250,166.96 oz. silver and 5,922.360 oz. gold. The cost per pound of refined copper produced during 1928, including depreciation and all charges except depletion, was 9.5267c. Price received per pound of copper sold f.o.b. refinery was 15.0236c.

BURMA CORPORATION, LTD., reports that during April, 38,232 tons of ore was mined, including 3,614 tons of high-grade. A total of 29,000 tons of ore was milled in the treatment plant, producing 10,035 tons of lead concentrates. A total of 11,054 tons of lead-bearing material, including 2,761 tons of high-grade ore, was smelted in the blast furnaces, producing 5,981 tons of hard lead for treatment in the refinery. Refinery products were 6,554 tons of refined lead and 625,327 oz. of refined silver. Of the total silver production 41,165 oz. was recovered from the treatment of copper matte. The zinc plant produced 5,180 tons of zinc concentrates, assaying 9.1 oz. of silver per ton, 4.6 per cent lead, and 51.7 per cent zinc. In addition to the above, 1,350 tons of copper matte was produced from the treatment of accumulated smelter byproducts, and 6,233 tons of copper ore.

Cerro Earned $10,190,867 Last Year

Financial results of Cerro de Pasco Copper Corporation and subsidiary companies for 1928 are as follows:

Consolidated Income and Expenditure Account

Income

Sales of metals	$25,261,249
Dividends, interest and miscellaneous earnings	1,347,314
Inventory of metals and concentrates at Dec. 31, 1928	6,736,020
	$33,344,584

Expenditures

Inventory of metals and concentrates at Dec. 31, 1927	$7,468,780
Operating, smelting, shipping, refining, and administration	12,052,285
Custom ores	2,792,014
United States and foreign taxes	840,635
Balance—To consolidated surplus account	10,190,867
	$33,344,584

Consolidated Surplus Account

Balance—Dec. 31, 1927	$505,403
Adjustment for capital distributions, as of Dec. 31, 1927	4,309,349
Balance—Dec. 31, 1927—adjusted	$4,814,753
Balance of income for year ended Dec. 31, 1928, from consolidated income and expenditure account	10,190,867
	$15,005,620
Reserves for depletion and depreciation	$4,434,539
Dividends paid	5,052,789
Less—Capital distributions $945,667	4,107,121
Balance—Dec. 31, 1928, per consolidated balance sheet	6,463,959
	$15,005,620

Cerro de Pasco produced 97,769,279 lb. of copper, 29,380,000 lb. of lead, 20,000,000 lb. of zinc, and 16,383,847 oz. silver, and 26,013 oz. gold in 1928.

CONSOLIDATED MINING & SMELTING COMPANY of Canada has purchased the George Gold-Copper Mines stockholdings of Mr. and Mrs. W. B. George, the discoverers of the property, for $171,000 cash as well as the stock of several of the smaller owners, which gives Consolidated 92 per cent of the stock in George Copper. During the last two seasons Consolidated has been exploring with several diamond drills the property owned by the George company, at the head of Bear River, in the Portland Canal division of British Columbia, and though, according to a statement in Consolidated's last annual report, it has not found the downward extension of the veins exposed on the surface, two bores have penetrated at depth 20 ft. of ore in another part of the property. This is a copper-zinc deposit without important precious metal content. It has not yet been found at the surface, but an attempt will be made to develop it by underground exploration during 1929.

ALASKA JUNEAU GOLD MINING COMPANY in May, 1929, mined and trammed 313,970 tons of ore to the mill, from which estimated receipts were $285,500, or 90.93c. per ton; operating expenditures, $167,750, or 53.43c. per ton, and operating profit was $117,750, or 37.50c. per ton. Other expenditures and accrued charges totaled $13,700, leaving a surplus of $104,050 for the month.

Treadwell Yukon Earned $12,996 in 1928

ANNUAL REPORT of the Treadwell Yukon Company, operating the Wernecke mines, in Yukon Territory; the Errington mines, in Ontario; and the Tybo mine, in Nevada, shows net profit of $12,996 on all operation for 1928.

Consolidated Profit and Loss Statement

Wernecke mines operations..... Net profit after all charges, as per statement attached.		$328,564
Prospect examination expenses (general exploration).....	$13,409	
General administrative expenses.	36,140	
Errington mines (Ontario).....	173,498	
Nevada mines.....	48,899	
Interest charges written off. McGrath, Alaska.....	32,939	304,887
Balance of property written off.		
Net profit for year from all sources		$23,676
Provision for 1928 income tax..		10,680
Net profit after all charges.....		$12,996
Deficit Dec. 31, 1927.....	$339,594	
Less adjustments applicable to 1927 and prior years.....	5,098	334,495
Deficit Dec. 31, 1928.....		$321,499

Of the 1,500,000 shares of Treadwell Yukon common stock issued, on March 25, 1929, a total of 750,000 shares was owned by Bunker Hill & Sullivan, 329,683 shares by Alaska Treadwell Gold Mining Company, 113,632 shares by Alaska Mexican Gold Mining, 146,573 shares by Alaska United Gold Mining, and a total of 160,112 shares by various individuals.

Complete production data are not shown in the company report.

London Financial News

By W. A. DOMAN
Special London Correspondent

LONDON, June 4, 1929—The political kaleidoscope has overshadowed markets during the last week. The city is not afraid of labor ascendancy, as office brings with it responsibility. Whatever political views may prevail, the public has done little on the Stock Exchange. In one direction there is an exception, and that again is Rhodesia. In mining circles, copper is talked. where previously tin held sway. Sir Edmund Davis addressed a special meeting a few days ago on "Recent Developments in Rhodesia." Being so greatly interested in copper, he naturally did not overlook it, and predicted that within the next eight years the copper belt in Northern Rhodesia will produce between 280,000 and 300,000 long tons of the metal annually. Zinc prospects also are good. But it is not Sir Edmund Davis alone who is keeping Rhodesia to the front. The strong advance in the price of Rhodesian Congo Border and in other Rhodesian shares is attributed in the main to buying on American account. When transatlantic financiers are intent on acquiring a property, rumor credits them with being ready to pay a price that discounts values two or three years ahead. In connection with Rhodesian Congo Border Concession the figure of £20 for the £1 share is being revived. Seven or eight months ago this height was suggested, and the halfway stage is already passed. This is caused partly by the receipt of recent favorable news from the property.

Southern Rhodesia Base Metals announces that it has granted to Rio Tinto —also interested in Northern Rhodesia copper—an option until the end of this year to purchase 75,000 of the unissued £1 shares at par.

A private cablegram from South Africa states that at the annual meeting of the Consolidated Diamond Mines of South-West Africa, the chairman expects the options on shares to be fully exercised. The money thus raised is to be used for the redemption of debentures, amounting to £1,223,200. At present the share capital is £2,830,000 in £1 shares, and these are to be divided into ordinary and preference. A million carats of diamonds are said to be developed in the new discovery on the north bank of the Orange River, and further rich terraces are said to have been located.

Santiago Sabioncello is still further enlarging his influence in the nitrate world here. It is announced that he has joined the board of Lautaro Nitrate, having secured a large interest in the syndicate.

Copper Range Reports Successful Year

Copper Range Company reports the following consolidated statement of operations for 1928.

Gross Income

24,254,132 lb. copper produced at average sales price of 15.017c. per lb.....		$3,642,176
Copper Range Railroad operating revenue		844,060
Interest.....		218,962
Miscellaneous.....		71,399
Total.....		$4,776,600

Deductions

Mining expense, smelting, freight, taxes, selling and general expenses.....	$2,905,221	
Copper Range Railroad operating charges, taxes and other debits.....	615,013	
One-half Champion profits belonging to St. Mary's Mineral Land Company...	414,678	$3,934,913
Operating profits.....		$841,686
Interest on Copper Range Railroad First Mortgage Bonds.....		114,000
Net income.....		$727,686
Depletion and depreciation.....		687,015
Net profit.....		$40,670

The average cost of producing and selling the year's output of copper was 11.9c. per pound.

AHUMADA LEAD COMPANY for the quarter ended March 31, 1929, produced 6,805 of dry tons of ore, for which the smelter returned 2,699,740 lb. of refined lead, an average of 396.7 lb. per ton. The sales for the three months were 2,699,740 lb. of lead.

Gross receipts therefrom and other sources were.....	$210,261
After deducting depreciation, taxes and all other expenses, the net loss for the period was.....	13,659
The company had on March 31, 1929, cash and cash assets of.....	186,347

Granby Consolidated Increases Net Profits

NET profit of Granby Consolidated Mining, Smelting & Power Company, Ltd., increased to $2,971,071 in 1928 from $1,428,579 in 1927.

Comparative Statement of Operations

	1928	1927
Gross revenue from operations	$9,942,397	$8,411,949
Operating costs.....	6,691,169	6,597,482
Gross profit from operations	$3,251,227	$1,814,466
Insurance, taxes, administrative expense.....	521,294	332,239
	$2,729,832	$1,482,227
Dividends from investments..	253,258	71,796
	$2,983,091	$1,554,023
Interest on bonds to date of redemption.....	12,019	125,444
Net profit to surplus.....	$2,971,071	$1,428,579

Dividends aggregating $1,782,142 were distributed to shareholders in 1928.

Production for 1928

	Anyox Plant	Allenby Plant	Total
Copper sold, lb....	35,637,267	25,373,815	61,011,082
Copper, lb.....	36,134,026	21,387,728	57,521,754
Silver, oz.....	279,885	150,775	430,660
Gold, oz.....	5,812	5,268	11,080

The average cost per pound for copper produced after allowing credits for precious metals and miscellaneous income, but exclusive of bond interest, depreciation, depletion and income taxes, was 9.188c. compared with 9.971c. for 1927.

Old Dominion Earned $177,729 in 1928

Net earnings of the Old Dominion Company, Arizona copper producer and subsidiary of Phelps Dodge Corporation, amounted to $177,729 in 1928.

Income Account for 1928

Income:		
Sales of copper, silver and gold.....	$3,289,679	
Income from investments and miscellaneous earnings	34,618	
Interest.....	24,797	$3,349,095
Expenses:		
Mining, treating and refining.....	$3,080,596	
Selling expense.....	21,476	
Depreciation.....	69,292	3,171,365
Income, before depletion, for 1928—carried to balance sheet.....	.....	$177,729

During the year there was mined 353,392 tons of ores of all classes, as compared with 356,697 tons in 1927. The average grade was 2.92 per cent copper in 1928, compared to 3.42 per cent in 1927, a drop of 0.50 per cent. The resulting fine copper produced was 17,717,267 lb., compared with 21,570,615 lb. in 1927.

SOUTHERN RHODESIA BASE METALS CORPORATION, LTD., has granted the Rio Tinto Company, Ltd., an option until the end of 1929 to purchase 75,000 of the unissued shares of the company at par—£1 per share. Rio Tinto Company, Ltd., has sent its chief geologist at its own expense to inspect the properties.

The Market Report

Activity in Lead Features Non-Ferrous Metal Markets

New York, June 19, 1929—The large volume of lead sales in the last two weeks indicates the existence of a moderate buying wave in that market. Otherwise, a state of unusual quiet has prevailed. With the exception of a slight stiffening in quotations for Prime Western zinc, prices continue unchanged but firm.

Copper Inactivity Continues

Again last week the expected improvement in demand for copper failed to materialize. In the domestic market sales were appreciably less, partly as a result of the failure of primary producers to make such large sales of special shapes for prompt delivery as in the week ending June 12. All business has been on the basis of 18c. delivered Connecticut Valley, however, and there is no indication of weakness in that price.

Copper Exporters, Inc., continues its c.i.f. price of 18.30c., usual European destinations. Sales in the foreign market continue at the rate of about 1,000 tons per day thus far in June, or approximately 50 per cent of the rate prevailing prior to the recent depression. The general outlook is unchanged, and a lack of any sustained buying may persist for several weeks yet, though the producers are quite firm in their refusal to break the established price of 18c. per pound.

According to the American Bureau of Metal Statistics, world production of copper amounted to 193,089 tons in May, or a daily rate of 6,229, compared with a total of 196,820 for April, or a daily average of 6,561 tons. The average monthly production during the first five months of this year was 185,715 tons, and the average daily output for the same period was 6,149 tons.

Lead Firmer, With Heavy Sales

The excellent buying of lead reported a week ago has continued, sales in the week ending today being the largest since the week ending March 6. All producers have shared in the business. In the East, the market has continued on the basis of 7c., New York, which is the American Smelting & Refining contract price. In the Middle West, the 6.80c., St. Louis, basis has been general since last Thursday, with 6.85c. the ruling price in Chicago, and 6.95c. established for corroding grades in the Chicago market. Corroders have been responsible for a large share of the demand, though good sales have been made by some sellers to cable manufacturers as well. Demand has been almost equally divided between June and July, though a substantial tonnage for August shipment was also sold.

Production in the United States and Mexico increased somewhat in May, and stocks of refined were over 12,000 tons higher at the end of May than a month before, but these data are not considered as a serious adverse factor, as they may be explained by the release of Mexican lead dammed up by the revolution. The increase in the London market to New York parity is encouraging. All in all, lead looks the firmest that it has for some time, though there is nothing to indicate that a price revision upward is being considered at present.

CORRECTION: The price of forward lead in London on March 25 was incorrectly cabled and published in these columns as £26⅞. It has just been called to our attention that the correct figure was £26¾. The average price for March was £25.584 instead of £25.591, as published.

Daily Prices of Metals

June	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
13	17.775	43.625	7.00	6.775@6.80	6.65
14	17.775	43 75	7.00	6.80	6.65
15	17.775	44 00	7.00	6.80	6.65
17	17.775	44 375	7.00	6.80	6.675@6.70
18	17.775	44 50	7.00	6.80	6.675@6.70
19	17 775	44.625	7.00	6.80	6.675@6.70
	17 775	44.146	7.00	6.798	6.669

Average prices for calendar week ending June 15, 1929, are: Copper, 17.775; Straits tin, 44.125; New York lead, 7.000; St. Louis lead, 6.788; zinc, 6.631; and silver, 52.625.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

June	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic bid						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
13	76⅛	74⅜	84¼	198⅜	201⅜	23 9/16	23½	26 3/16	26 1/16
14	75¾	74⅝	84½	197¾	200⅞	23⅝	23 9/16	26 3/16	26 1/16
17	75⅛	74⅜	84¼	201	204¼	23 11/16	23 11/16	26 1/16	25⅞
18	74 11/16	74⅛	83¾	201¼	204⅝	23 15/16	23 13/16	26 3/16	26
19	73⅜	73⅝	83¾	201½	204⅞	24	23 13/16	26⅛	25 15/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

June	Sterling Exchange "Checks"	Silver		Gold London	June	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
13	4.84¼	52⅝	24 5/16	84s11½d	17	4.84¼	52¾	24 7/16	84s11½d
14	4.84¼	53	24 7/16	84s11½d	18	4.84¼	53	24½	84s11½d
15	4.84¼	52⅝	24⅜	.....	19	4.84¼	52⅝	24 7/16	84s11½

Average: Silver, 52.771c.; Sterling Exchange, 484.250c.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Zinc Quotations Higher

Sales of zinc continue in small volume. However, despite the lack of active demand, sellers of custom zinc in the open market have found it advisable to advance their quotations approximately $1 per ton, so that today the prevailing quotation is 6.70c. per pound, with a possibility of securing some metal at 6.675c. Confidence is quite prevalent throughout the trade that it is only a matter of time until the producers' price of 6.80c. per pound will be generally realized.

CORRECTION—Prices of London zinc for June 6, 1929, were incorrectly transmitted and published in *E.&M.J.* of June 15, as £26 10s. for spot and £26 7s. 6d. for three months. The quotations should have been £26 5s. for spot and £26 2s. 6d. for three months.

Tin Slightly Higher

Tin has sold in moderate volume this week, with slightly higher levels being maintained, for which the news from London regarding possible control of production seems largely responsible. A plentiful supply of tin for spot delivery is available, which has depressed prices somewhat. For delivery in August, premiums of about ¾c. are charged, and September and later months command 1c. or more above spot prices. Most interests are maintaining their position by selling spot and buying forwards.

Silver Quiet and Steady

During the last week the silver market has been quiet and steady, the price fluctuating between 52⅜ and 53c. Moderate demand from China and small orders from India have been the chief support of the market. The closing is quiet.

Mexican Dollars (old Mexican pesos): June 13th, 39⅞c.; 14th, 40¼c.; 15th, 39⅞c.; 17th, 40c.; 18th, 40¼c.; 19th, 39⅞c.

Sterling Below Gold Point

Sterling has declined sufficiently to bring about gold shipments from London to New York. Closing cable quotations on the principal foreign exchanges on Tuesday, June 18, were: Francs, 3.91½c.; lire, 5.23½c.; and marks, 23.86c. Canadian dollars, $\frac{1}{8}$ of 1 per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 8⅞c. per lb. for all positions. Cookson's "C" grade, spot, 14c.

ERRATUM — Quotation for Chinese antimony was incorrectly stated in *E.&M.J.* of June 15 as 8⅞@9c. per lb. The quotation should have been 8⅞c. per lb.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM — Per lb., New York: 80@95c. Active demand.

IRIDIUM — Per oz., $230@$240 for 98@99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, $68 per oz. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $120@$121. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of June 8.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $15@$15.50; Western scheelite, $15.50, for future delivery based on present tariff. Nominal.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the June 8 issue.

Car Shortage at Tri-State Mines Possible

Joplin, Mo., June 15, 1929

Blende	Per Ton
High	$47.00
Premium blende, basis 60 per cent zinc	$44.00@ 46.00
Prime Western, basis 60 per cent zinc	43.00@ 44.00
Table concentrates, 60 per cent zinc	41.00@ 43.00
Flotation concentrates, 60 per cent zinc	39.00@ 41.00
Average settling prices, all zinc concentrates	44.34
Galena	
High	$92.40
Basis 80 per cent lead	90.00
Average settling prices, all lead concentrates	90.92

Shipments for the week: Blende, 11,692 tons; lead, 1,657 tons. Value all concentrates the week, $669,050.

Both the zinc and lead concentrates market continued unchanged with normal demand all week. Ordinarily the smelters have a considerable tonnage of ore in mine bins contracted ahead for shipment, but during the last two months they have had only a week's purchase ahead for shipment. However, this week a start was made again to accumulate contracted ore in mine bins by shipping approximately 800 tons less than was purchased last week. A car shortage may develop soon, as the transportation companies will need an increased number of cars throughout the wheat belt for moving grain, and it is customary to begin distributing cars suitable for conveying grain to the wheat belt several weeks before harvest time.

Platteville, Wis., June 15, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$46.75
Lead Ore	
Lead, basis 80 per cent	$90.00

Shipments for the week: Blende, 648 tons; lead, none. Shipments for the year: Blende, 15,991; lead, 760 tons. Shipments for the week to separating plants, 1,155 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the June 8 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Market more active.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate, Sodium Nitrate, and Zinc Oxide are unchanged from prices in the June 8 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $33@$34 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.35@$1.50 f.o.b. works. Market strong.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the June 8 issue.

Rolled Metals

Copper, Lead, Zinc, Monel Metal, and Nickel Sheets are unchanged from prices in the June 8 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of June 8.

Iron, Steel and Coke

IRON—Per gross ton, Valley furnaces, Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL—Base prices per gross ton Pittsburgh, billets and slabs, $35@$36; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE—Per gross ton, Connellsville furnace, $2.75@$2.85. Connellsville foundry, $3.75@$4.85. Byproduct coke. Ohio and Kentucky (Connellsville basis) $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended June 15, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	112⅛	103⅜	112⅛	Mr.29,My.20	Q 1.75
Andes Copper	New York	53⅜	50⅛	53⅜	Mr.29, My.6	Q 0.75
Arizona Com	Boston	3⅛	2⅛	2⅞	Ja. 16, Ja. 31	S.A.0.25
Calumet & Ariz	New York	131½	126	131½	My.31, Je.17	Q 2.50
Calumet & Hecla	Boston	43½	41½	43	My.31, Je.29	Q 1.00
Cerro de Pasco	New York	161⅞	93	101⅞	Ap.11, My. 1	Q 1.50
Chile Copper	New York	87	87	87	Je. 1, Je.28	Q 0.87½
Con. Coppermines	N. Y. Curb	13	11	12½		
Copper Range	Boston	24	22⅜	22⅜	Je. 15, Jl. 15	Q 0.50
East Butte	Boston	3⅛	3	3	Dec., 1919	0.50
Granby Con	New York	75½	72½	75½	Ap.12, My.1	Q 1.75
Greene Cananea	New York	156⅜	146⅜	156	Je. 6, Jl. 1	Q 2.00
Howe Sound	New York	68½	61⅛	68	Mr. 30, Ap. 15	Q1.00
Hudson Bay	N. Y. Curb	17⅜	16⅛	16⅜		
Inspiration	New York	46⅜	42⅜	46⅜	Je.13, Jl. 1	Q 1.00
Isle Royale	Boston	23½	22½	22⅜	My. 31, Je.29	0.50
Kennecott	New York	86	81⅛	86	My. 31, Jl. 1	Q 1.25
Magma Copper	New York	70½	66	70½	Je.28, Jl.15	Q 1.25
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	43⅛	40⅜	43	My1, My15	Q 1.00
Mohawk	Boston	55	54	55	Ap. 30, Je. 1	Q 1.50
Mother Lode	New York	3⅞	3½	3⅜	Je. 13, Je. 29	0.20
Nevada Con	New York	47⅜	45⅜	47⅜	Je. 14, Je. 29	Q 0.75
Noranda	N. Y. Curb	53	51⅛	53		
Ohio Copper	N. Y. Curb	2⅛	1⅛	1⅛	Sept., 1926	0.03
Old Dominion	Boston	11	10½	11	Dec., 1918	1.00
Phelps Dodge	New York	64⅞	61⅜	64	Je. 4, Jl. 1	Q 0.75
Quincy	Boston	37⅜	36	37	March, 1920	1.00
Roan Antelope	N. Y. Curb	52⅛	47⅜	50		
St. Mary's M. L.	Boston	37⅜	34⅛	35	Fe.25, Mr.12	2.00
Seneca Copper	New York	5⅜	5⅛	5⅛		
Shattuck Denn	N. Y. Curb	17⅛	16⅛	17⅜		
Sherritt-Gordon	Toronto	7.40	7.00	7.25		
Tenn. C. & C.	New York	18⅛	18	18⅛	My.31, Je.15	Q 0.25
United Verde Ex	N. Y. Curb	18⅛	18	18⅛	Ap. 4, My. 1	Q 1.00
Utah Copper	New York	....	....	290	Je. 14, Je. 29	Q 4.00
Waite-Ack.-Mont	Toronto	6.25	4.15	6.00		
Walker Mining	Salt Lake	4.00	3.92½	3.95		
Wenden Copper	N. Y. Curb	1⅛	1⅛	1⅛		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	2½	2	2		
Amer. Z. L. & S.	New York	29⅛	27	29½	May, 1917	1.00
A. Z. L. & S., pfd.	New York	95	95	95	Je.14, Jl. 1	1.50
Bingham Mines	Boston	5⅛	52	52	Mr.15, Ap.5	0.50
Bunker Hill & S.	N. Y. Curb	140	140	140	Ap.25, My.6	X 0.75
Butte Cop. & Zn.	New York	5⅛	4⅞	5		
Butte Cop. Con.	Boston Curb	31	30	31		
Butte & Sup.	New York	8	7	7	Je. 14, Je. 29	Q 0.50
Callahan Zn-Ld.	New York	2	1⅞	2	Dec., 1920	0.50
Chief Consol.	Salt Lake	3.25	2.90	3.25	Fe. 1, 1928	K 0.10
Consol. Ld. & Zn. "A"	St. Louis	16	16	16	Ap.5, Ap.10	0.25
Constitution	Spokane	*38	*35	*35		
Dayrock	Spokane	3.00	2.75	3.00	Je.20, Je.30	0.03
Dickens Consol.	Spokane	*4⅞	*4⅛	*4⅛		
Eagle-Picher	Cincinnati	16⅛	16⅛	16⅛	Je. 30, Jl.15	Q 0.20
Eagle-Pich., pfd.	Cincinnati	....	....	102	Je. 30, Jl. 15	Q 1.50
Erupcion	Boston Curb	*10	*10	*10	Ja. 1, 1928	Q 0.07½
Eureka Bullion	Salt Lake	*85	*74	*83		
Eureka Lilly	Salt Lake	....	....	1.42½		
Eureka Standard	Salt Lake	....	....	3.32½		
Evans-Wallower	N. Y. Curb	21⅛	18⅛	20⅜		
Evans-Wal., pfd.	N. Y. Curb	....	....	84½	Je.20, Jl. 1	Q 1.75
Federal M. & S.	New York	....	....	217	Je., 1927	10.00
Fed. M. & S., pfd.	New York	100½	99⅞	100½	My.24, Je.15	Q 1.75
Gladstone	Spokane	*11	*10½	*10½		
Golconda	Spokane	1.27	1.17	1.17	Je.15, Jl.1	0.02
Grandview	Spokane	*40	*37	*37		
Hecla Mining	N. Y. Curb	17⅛	17⅛	17⅛	My.15, Je.15	Q 0.25
Highland-Surprise	Spokane	*14½	*13	*14½		
Jack Waite	Spokane	* 9½	*8½	*8½		
Kootenay Florence	Spokane	*15	*14	*15		
Lucky Jim	Spokane	*12	*10	*10		
Lucky Tiger-C.	Kansas City	†4.00	†3.50	....	Je.10, Je. 20	M 0.05
Mexican Premier	Spokane	2.44	2.37	2.37		
National Lead	New York	1.43⅛	1.42½	1.43⅛	Je. 14, Je. 29	Q 1.25
Natl. Lead, pfd. A	New York	139½	138½	138½	Mr. 1, Mr. 15	Q 1.75
Natl. Lead, pfd. B	New York	120	118	120	Jy. 19, Au 1	Q 1.50
N. J. Zinc, new	N. Y. Curb	79½	78	78½	Je.1, Je.14	X 0.50
New Quincy	Salt Lake	4.00	3.20	3.45	My.15, My.27	Q 0.10
Noble Five	Spokane	*55	*50	*54		
North Lily	Salt Lake	....	....	7.60	Jan. 20	Q 0.25
Park Bingham	Salt Lake	10	8½	8½		
Park Utah	New York	8½	7⅞	8⅛	Je. 14, Jl. 10	Q 0.20
Pend Oreille	Spokane	5.00	4.25	4.75		
Rico Argentine	Salt Lake	*35	*32	*35	No. 30, De. 15	Q 0.03
Ruth-Hope	Spokane	*32	*30	*32		
St. Joseph Lead	New York	70½	66½	69½	Ju. 8, Ju.20	QX 0.75
Sherman Lead	Spokane	*33	*31	*33		
Silver King Coa.	Salt Lake	....	....	13.00	Je. 20, Jl. 25	Q, 0.25
Silversmith	Spokane	*15	*12½	*13	Oct., 1926	Q 0.02
Sunshine Mining	Spokane	3.04	2.95	3.00	Je. 10, Je. 20	BM0.05
Tamarack-Custer	Spokane	*60	*58	*60	Sept., 1924	0.25
Tintic Standard	Salt Lake	13½	13½	13½	Je. 17, Je. 29	QX 0.30
Tonopah Belmont	N. Y. Curb	....	....	*56½	Oct., 1925	0.05
Treadwell-Yukon	Toronto	10.75	10.00	10.00		
United Zinc Smg.	N. Y. Curb	*62½	*62½	*62½		
Utah Apex	Boston	33½	33¼	33½	May 15, June 1	0.25
Utah Met. & Tun.	Boston	1⅛	*90	1	Dec., 1917	0.30
Whitewater	Spokane	*73	*70	*73		
Yellow Pine	Los Angeles	....	....	*8	Dec., 1925	QX 0.04
GOLD						
Alaska Juneau	New York	7	5⅛	6⅛		
Barry-Hollinger	Toronto	*31	*27	*27		
Central Manitoba	Toronto	*48	*45	*47		
Coniaurum	Toronto	....	....	*40		
Cresson Consol.	N. Y. Curb	*75	*68¼	*68¼	Mr.30, Ap.10	Q 0.02
Dome Mines	New York	10⅛	9⅛	10⅛	Mr.30, Ap..20	Q 0.25
Golden Cycle	Col. Springs	†1.95	†1.91	....	Fe.15, Mr. 1	0.04
Gold Hill	Toronto	*3	*2	*2½		
Hollinger	Toronto	5.80	5.55	5.70	Je.20, Je. 25	M 0.05
Homestake	New York	73	73	73	My.20, My.25	M 0.50
Kirkland Lake	Toronto.	*99	*89	*92		
Lake Shore	Toronto	24.25	23.50	24.25	Je.1, Je.15	Q 0.20
McIntyre-Porc.	New York	16⅛	16⅛	16⅛	My.1, Je.1	Q 0.25
Portland	Colo.Springs	†*11	†*10	....	April, 1927	0.02
Rand Mines	New York	....	....	35	Fe. 21,'28	Am.Sh.1.52
Siscoe	Toronto	*65	*56	*62		
Sylvanite	Toronto	1.30	1.24	1.24		
Teck-Hughes	Toronto	8.95	8.10	8.60	Ap. 7,My 1, O	0.15
Tom Reed	Los Angeles	*27⅛	*19½	*27⅛	Dec., 1926	0.02
Unity Gold	N. Y. Curb	1⅛	1⅛	1⅛		
Vipond Consol	Toronto	*90	*85	*90	April, 1927	0.03
Wright-Hargreaves	Toronto	1.45	1.33	1.45	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb	....	....	35⅛		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	17⅛	15⅛	15⅛		
Castle-Trethewey	Toronto	*32	*30	*32		
Consol. Cortez	N. Y. Curb	*12½	*12½	*12½		
Dolores Esperanza	N. Y. Curb	*75	*75	*75	July, 1923	0.05
Keeley	Toronto	*50	*44	*50	Mr.15, 1928	0.04
Mining Corp.	Toronto	4.20	3.90	3.95	My 30, Je.13	0.12½
Montana-Idaho	Spokane	*13⅛	*10⅛	*12⅛		
N. Y. & Hond. Ros.	N. Y. Curb	....	....	17⅜	Ap.17,Ap.27	QX 0.05
Nipissing	N. Y. Curb	2⅛	2⅛	2⅛	Je.29, Jl.20	Q 0.07½
Premier Gold	N. Y. Curb	1⅛	1⅛	1⅛	Je.13, Jl.3	Q 0.06
Tonopah Exten.	N. Y. Curb	....	....	*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	3⅛	3	3⅛	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	*37⅞	*31⅛	*37⅞		
Yukon Gold	N. Y. Curb	*87⅞	*68⅛	*68⅛	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	107⅞	98⅛	106⅜	Jl.19, Au.15	Q 1.00
Beth. Steel, pfd, 7%	New York	118⅛	117⅛	118	Je.1, Jl.1	Q 1.75
Cleveland-Cliffs	Cleveland	140	85	85	Je. 6, Je. 15	5.00
Colo. Fuel & Iron	New York	63	56	62		
Colo. F. & I., 1st pfd.	New York	....	....	78	My.10,My.25	Q 2.00
Great Northern Iron.	New York	29⅜	27⅛	28⅛	Dec.15,	K 2.00
Inland Steel	New York	90	88	90	My.15, Jn. 1	Q 0.87½
Republic I. & S.	New York	94⅜	88	92⅜	My. 11, Je. 1	Q 1.00
Republic I. & S., pfd.	New York	111	110⅛	111	Je .12, Jl. 1	Q 1.75
Sloss-Sheffield S. & I.	New York	63	59½	63	Mr. 11, Mr.20,	Q 1.50
Sloss-Sheff. S. & I., pfd.	New York	95	95	95	Je.20, Jl.1,	Q 1.75
U. S. Steel, new	New York	167	167	167		
U. S. Steel	New York	177⅛	165⅛	175⅛		
U. S. Steel, pfd.	New York	140⅛	140	140⅛	My. 4,My 29,	Q 1.75
Virginia I. C. & C.	New York	....	....	25⅛	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	45	45	45	Jl.16, 1928	SA2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	294	279¾	286		
Alum.Co.of Amer., pf.	N. Y. Curb	107⅛	107	107	Mr.15, Ap.1,	Q 1.50
American Metal	New York	59	55⅛	58⅛	My.9, Je. 1	Q 0.75
Amer. Metal, pfd., 6%	New York	115⅛	115½	115½	My.21, Je.1,	Q 1.50
Amer.Sm. & Ref.	New York	102⅛	97⅞	102⅛	Ap.12, My.14	Q 1.00
Amer. & Sm. Ref., pfd.	New York	133⅛	133	133	My. 3, Ju. 1	Q 1.75
Ang. Ch. Nitrate	N. Y. Curb	40⅛	37⅛	39⅞		
Asbestos Corp.	Montreal	11	10⅛	10⅛	Jan. 1926	1.50
Asbestos Corp., pfd.	Montreal	35	35	35	De. 31, Ja. 15	Q 1.75
Consol. M. & S.	Montreal	390	385	390	De.31,Ja.15,SA	X6.25
De Beers Consol.	New York	....	....	23	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	30	29	30	Mr.27, Ap.5	Q 0.75
Freeport Texas	New York	46⅜	45	45½	Ap. 5, My. 1	Q 1.00
Int. Nickel Can.	New York	49½	46⅜	49½	Je.1, Je.29	Q 0.20
Int. Nickel, pfd.	New York	120	120	120	Jl.1, Au.1	Q 1.75
Mayflower Assoc.	N. Y. Curb	70	65⅛	70		
Metal & Mining	N. Y. Curb	20	19⅛	20	Je.20, Jl.1	Q 0.30
Newmont	N. Y. Curb	200	195⅛	200	Mr.30, Ap.15	Q 1.00
Patiño M. & E.	New York	37	36	37	My. 31, Jn. 28	4s
So. America G. & P.	N. Y. Curb	2⅛	2⅛	2⅛		
Texas Gulf Sulphur	New York	73⅞	71⅞	73⅛	Je.1, Je.15	Q 1.00
U. S. Sm. R. & M.	New York	57⅛	53½	56	Ap. 4, Ap. 15	Q 0.87½
U. S. Sm. R. & M., pfd.	New York	52⅛	51⅛	52	Ap. 4, Ap. 15	Q 0.87½
Vanadium Corp.	New York	82⅛	73⅛	80⅛	Fe.1, Fe. 15	Q 0.75

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumption. X, Extra. The first date given is that of the closing of the books: the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED June 4, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	60/—	55/—	55/7½	Nov., 1926	4 p.c.(d)
Aramayo Mines (25 frs.)	60/—	60/—	60/—	May 1929	5 p.c.(†)
Burma Corp (10 rupees)	18/9	17/6	18/9	Feb., 1929	7 annas*
Bwana M'Kubwa (5s)	20/6	19/—	19/10½		
Camp Bird (2s)	2/4½	2/—	2/3	April, 1928	16⅔ p.c.
El Oro (£1)	5/—	4/9	5/—	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£)	8/7½	8/7½	8/7½	Jan., 1929	3¾ p.c.
International Nickel of Canada (Quoted in dollars with a fixed rate of $5 to the £1) (no par value)	$48⅛	$46⅞	$48⅛	Mar., 1929	20(c)
Mexican Corpn. (£1)	14/3	13/—	14/—		
Mexico Mines of El Oro (£1)	7/9	5/9	6/—	Dec., 1926	3¾ p.c.*
Mount Isa (£)	45/6	43/1½	44/4½		
N'Changa Copper Mining. (£1)	84/4½	75/—	81/3		
Oroville Dredging (4s)	1/9	1/7½	1/9	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	10⅜	8⅜	10⅛		
St. John del Rey (£1)	17/9	17/1½	17/9	Apr., 1929	7½ p.c.
San Francisco Mines (10s)	36/9	36/3	36/9	Jan., 1929	25 p.c.
Santa Gertrudis (£1)	10/9	10/3	10/6	Jan., 1929	7½ p.c.
Selukwe (2s. 6d.)	6/3	5/4½	6/—	April, 1917	6¾ p.c.
S. Amer. Copper (2s.)	2/7½	2/1½	2/4½	Nov. 1917	75 p.c.
Tanganyika (£1)	60/—	57/3	60/—July,	1928	5 p.c.
Union Miniere de Haut-Katanga (Brussels)	11,625	11,510	11,520	April, 1929	300.00 fr.

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation. (d) U. S. Dollars.